

DIATHERMY THERAPY

SEVENTH
REVISED
EDITION



Published By
RESEARCH DEPARTMENT

H. G. Fischer & Company, Inc.
Physical Therapy Headquarters
2323-37 Wabansia Avenue
Chicago, Illinois

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PREFACE

APPRECIATING the need of establishing standard technics applicable to the treatment of the various conditions in which diathermy is indicated, especially among medical men who are just entering the physiotherapeutic field, we have attempted in this publication insofar as possible to supply this much needed information.

Many physicians and surgeons using diathermy today are pioneers in the field, and employ whatever technic they, through experience, have found gives the best results. These men have adopted procedures that may be regarded as standard. We find that the successful men, even where widely separated, have come to use practically the same general technic in their work, and in the preparation of this book of therapy, we have been careful to incorporate only that which has been adopted by a sufficient number of physicians as safe, reliable, and efficient.

While diathermy as an electrical modality is a constant element, the reactions of the human body differ widely in different individuals. Furthermore, the same individual does not react the same at all times, and in the use of diathermic energy, as in the administration of medicines, the physician must use both caution and judgment, study each case individually, and adjust his technic to suit conditions.

Neurotic patients often have an extreme fear of any electrical treatment, which they associate with electrical shock and high tension burns about which almost everyone has some knowledge. In treating such patients, the operator must endeavor to inspire their confidence by his attitude and make them understand that he is not carrying out an experiment, but that he knows exactly what he is doing and is confident of the results to be obtained. He should check his connections, the application of the electrodes, and the setting of the machine before starting the treatment.

While diathermy is doubtless as safe as any agent used in the practice of medicine and surgery, it is possible to abuse it and produce burns, or uncomfortable sensations to the patient. We have endeavored, in this book, by furnishing reliable information regarding the application of this physical agency, to remove all doubt and to inspire confidence.

It is our hope that by the publication of this Book of Therapy we will aid in the advance of physical therapy science.

Research Department,

H. G. FISCHER & CO., Inc.

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NOTE—All indications and treatments are arranged alphabetically, which makes the section of Diathermy Therapy *self-indexing*.

MEDICAL DIATHERMY

For convenience in therapeutic applications, Diathermy has been classified under two heads. First: Medical or constructive diathermy and Second: Surgical or destructive diathermy, the dividing line being where stimulation ceases and disintegration begins. There is no difference in the two types except in the amount of heat energy produced at a given point.

Medical diathermy is mild and produces an increase of physiological, or we might say, metabolic reactions, while in surgical diathermy the degree of temperature is so intensified that all metabolic reactions are destroyed and the tissues are blanched, desiccated, coagulated, or charred according to the intensity of the current.

Medical diathermy is applicable in the treatment of painful or infectious conditions where it is desired to increase the physiological reactions of the body for the purpose of combating infection, by increasing the phagocytic properties of the blood stream, and accelerating the absorption of disintegration products and debris. Heat also, has analgesic properties and except in cases where suppurative material is confined under pressure, medical diathermy is very useful for the relief of pain.

Physicians appreciate the value of the application of heat to the body and have used convective, radiant, and conductive heat, in many instances in addition to chemistry.

The methods employed for this purpose fail in most instances because they do not penetrate, but only heat near the surface. In speaking of Diathermy we speak of *conversive* heat (high frequency currents through the body)—heat from within—heat that is developed, by the passage of an electric current, within the tissues themselves, and this heat can be generated at any depth.

As Chas. E. Stewart, M.D., says,¹ "In Diathermy the physician has at his service a method possessing a wide range of flexibility by means of which he can make thermic applications of varying degrees of intensity to almost every part of the body."



*Fischer Hospital Portable
Diathermy Unit, Type
"G2" on Mobile Cart*

¹Am. Jour. Phys. Ther., Jan., '27.

About twenty-five years ago D'Arsonval, a French professor, demonstrated that when an electrical current reversed its direction oftener than 10,000 times per second, muscle contractions ceased entirely. Since this time electrical currents of frequencies very much higher have been experimented upon, and these currents were finally named Diathermy currents by Nagleschmidt of Germany. Dia—thru and Thermy—to heat.

Then came various methods of applying Diathermy Currents and various voltages under which it was used. Three names applied to these Diathermy Currents still remain quite popular. They are, D'Arsonval, Tesla and Oudin. They are all essentially the same and the terms may well be discarded. Ordinarily D'Arsonval Currents are spoken of as fairly low voltage currents approximating from 1,000 to 5,000 volts. Tesla Currents often run as high as 25,000 or even 30,000 volts while Oudin is usually considered from 30,000 to 100,000 volts.

The sensation engendered by Diathermy within the human system, or within the part under treatment, is one of heat only. The circuit is under complete control of the operator and when properly adjusted is absolutely devoid of any faradic sensation.

Medical Diathermy is used to produce heat within the tissues within physiological limits, the object being to temporarily increase congestion and promote a more rapid flow of blood, the reaction following decreasing congestion with the resultant drainage of poisons from the affected area, all of which is accomplished at a comfortable heat toleration.

Medical diathermy is applicable in all instances in which the therapeutic effects of heat within the tissues is beneficial.

The ability to generate the heat *within the tissues* is the paramount advantage of Diathermy over any other method. In fat people the peripheral layer of fat acts as an insulator so that little or no benefit to the deeper tissues is ever produced by external applications of heat.

By Diathermy, we may administer heat to whatever depth desired and may intensify or decrease its concentration at will. Medical diathermy produces a vasodilatation of the arterioles and venules, thereby increasing the vascularity of the part. There is also an increase in the concentration of the hemolytic enzymes which increases the phagocytic activity of the white blood cells, thereby combating infection by nature's process and at the same time hastening the absorption of devitalized tissue and waste products.



Model "C-D-C" Senior
Diathermy Cabinet

Quoting from Kolischer, Diathermy increases nutrition oxygenation, hastens the elimination of waste and toxic products and furnishes a better supply of the various substances that are locally required in combating infections. There is often a relaxation of other tissue elements, such as spasmodic muscles, tense nerves and similar conditions.

Edwin N. Kime, M.D., points out² that both medical and surgical diathermy in the hands of the skilled medical man are valuable adjuncts, and when administered with proper technic in suitable cases appear to be almost specific in many hitherto hopeless conditions. Geo. W. Funck, M.D., says,³ when diathermy heat is applied to any part of the body, the tissues react in a certain definite way. It produces a local vasodilation of the arterioles, capillaries and veins, and

a similar effect in the corresponding lymph channels; the result is an increased fluid irrigation of the area; more blood and lymph flows through in a unit of time.

Neymann states,⁴ that after Diathermy the blood picture changes. Red blood corpuscles, white blood corpuscles and hemoglobin increase. Chemical examination of the blood reveals decided changes. There is an increase in the nonprotein nitrogen and uric acid content of the blood.

From what has been said, it would follow that Diathermy is beneficial in the following conditions:

1. Conditions requiring local increase of the blood supply.
2. Conditions requiring increase in rate of metabolism, oxidation, phagocytosis, antibody formation, and etc.
3. It increases the elimination of waste products.
4. It relieves tension.
5. It supports and maintains a healthy metabolism.
6. It relieves pain due to congestion.

²Indianapolis Med. Jour.
³Am. Jour. Phys. Ther., Oct., '29.
⁴U. S. M. A. J., Jan., '31.

The general indications for Medical Diathermy are:

1. Chronic local debilitated conditions.
2. Acute and chronic inflammations.
3. Toxic states.
4. Neuroses.

As examples of these conditions, we might mention:

1. Chronic ulcers, varicose ulcers; eczema, the dry, scaly form; non-united fractures; trophic sores; chronic arthritis; muscular atrophy, etc.
2. Tuberculosis, pulmonary, bone, and gland; urethritis, prostatitis; metritis, cervicitis, salpingitis; otitis media; osteomyelitis; neuritis.
3. Pneumonia; pleurisy; arthritis.
4. Nephritis; toxic fevers and acidosis.
5. Idiopathic hypertension; psychoses, autonomic imbalance.

By the employment of properly sized and shaped electrodes and the proper technic, we are able to deliver to areas of any size, not only greatly varying degrees of heat but accurately measured dosage. This heating may be general or localized to small sections by simply varying the technic of application. The result is accomplished with no sense of shocking or so-called electrical sensations on the part of the patient; in fact, the patient should never feel any other sensation than that of the required, comfortable warmth.

Briefly, medical Diathermy produces internal heating (or what we might term an internal poultice), offers relief of venous and visceral congestion, creates capillary hyperemia, has marked analgesic properties, stimulates cells, glands, and the vasomotor nerves, and is used to exceptional advantage in:

Pneumonic infiltrations	Ankylosed Joint	Chronic Urethritis
Industrial injury cases	Lumbago	Gonococcal infection
Absorption of callouses and deposits	Neuralgias	Traumatic injuries
Chronic Kidney conditions	Sciatica	Pelvic inflammation
Congestion of liver	Myalgias	Angina Pectoris
Old skin fibrosis	Orchitis	Muscular Atrophy
Neuritis	Endocervicitis	Bronchial congestion
	Epididymitis	And for the relief of pain
	Arthritis	

It is impossible to give a definite list of conditions for which Diathermy is available. Any such list, however long, would be sure to lack completeness. Diathermy is of value wherever heat

is indicated. The only way for the prospective user of Diathermy to learn how to supply it, is to keep in mind its general effects, and to keep in mind the indications in his patients for these effects. If he does that, he will discover new uses for Diathermy every day.

Diathermy applications are biterminal, and while on first observance the general technic seems exceedingly complicated, it is in reality very simple. Proper attention must be paid to the seemingly small details of an average diathermy application.

Diathermy dosage will naturally vary from as low as 50 M.A. up to as high as 6000 M.A. and over, to correspond with the type of case under treatment as well as the square inch surface area of the electrodes. There is an accepted rule that 500 M.A. for each 7 square inches of surface covered should not be exceeded.

Start the treatment with a very low milliamperage, that is, with the spark interrupter points adjusted almost closed, and increase the current gradually to the desired maximum, holding the current volume at that point for the duration of the treatment and then gradually reducing again to zero before throwing off the current. This will produce a thorough and even heating in the tissues.



*Fischer Model G-3
Diathermy Cabinet*

In the latest model Fischer Diathermy outfit all possibility of faradic sensation at any given point of voltage or amperage is overcome. There is no rheostat, choke or other primary control, on this machine. The control is obtained from an additional solenoid coil, loose coupled, and while the entire current is across the gap at all times, the volume is controlled by the adjustment of this loose coupled solenoid coil.

This serves the double purpose of control from absolute zero to maximum without a break in the circuit, and as the control is graduated, a precision adjustment can be repeatedly made at any voltage required.

Contra Indications

Pus without drainage.

Pelvic area during pregnancy or menstruation.

Beware of areas of anaesthesia—or apply after sensibility returns.

EFFECTS OF DIATHERMY CURRENTS



Diathermy Clamp Applied to the Shoulder. Heating effect is apparent straight through.

When electrodes of equal size are applied to opposite sides of a limb or trunk, the heating effect will be apparently uniform straight through.

By using a large electrode on one side and a small electrode on the opposite side, the intensity of the resultant heat will be in exact inverse ratio of the square inch area covered. It is easily possible to concentrate so much heating under a very small electrode as to produce actual coagulation. Note the relative size of these squares:

If electrodes of the above proportions were placed on opposite sides of a limb, the heating effect under the four squares (Fig. A) would be four times as great as under the sixteen squares (Fig. B) because of the concentration of the same amount of energy on each.

Before applying diathermy to the human body some knowledge of its actions on the tissues is quite necessary. Diathermy currents follow the path of least resistance when passing through the body.



Fig. A



Fig. B

The heating power of diathermy currents (high frequency currents) is not alone in the resistance of the tissues to the flow of the current, but also due to the fact that the tissues of the body between the electrodes completes a condenser by becoming the di-electric between the metal electrodes. These tissues, therefore, are additionally heated by the eddy currents which flow uninterrupted in all directions between the electrode plates.

When active pointed electrodes are used it is well to remember that the tissues immediately surrounding such active point will quickly coagulate. Depth and breadth of coagulation can be more accurately determined with biactive needles.

In considering the physiological effects of diathermy to the human body, we need but refer to Dr. Bier's famous work on hyperemia. He points out the inhibitory effect on bacteria—he also strongly points out the relief of pain, the absorption of disease deposits and the beneficial nourishment of the heated area.

All this is borne out by Crile's work in his study of the chemical effect on tissues and organs. Dr. Crile claims a 10 per cent drop in the chemical activity of the liver for every degree centigrade drop of temperature. He points out this danger during major operations and uses diathermy to help maintain normal temperature in such critical instances.

Experience by others has proven that wherever chemical physiology is retarded, that its chemical velocity may be restored by medical diathermy.

A diathermy treatment should be started with but a small amount of current. The volume should be increased gradually, arriving at the maximum amount of milliamperage in about five minutes' time. This technic means an even distribution of the heat and no trouble with hot spots at the electrodes. On the other hand, when starting the treatment with a great volume of current abruptly, practically all of the heating will concentrate near the surface right under the electrodes, with a resultant drying out of the conducting materials, water, soap lather, etc., that you may have applied, as well as the skin itself. Your patient will be uncomfortable and will complain of hot spots and pricking sensations. These conditions must be avoided. Starting the treatment with a moderate current and gradually increasing the volume—especially when using electrodes of unequal size—is absolutely necessary; otherwise the heating will be concentrated very noticeably at the surface immediately under the smaller contact.

Bone and scar tissue offer great resistance to the passage of diathermy; tissue and moist skin offer very little resistance. Muscle and bone retain the heating from the diathermy treatment for a long period, while most of the skin heating is dissipated by radiation; and the tissues immediately beneath the skin lose most of the heat through conduction by the dilated blood vessels.

To recapitulate: The following factors must be considered in giving a diathermy treatment:

- Resistance of the skin
- Amount and character of tissue between electrodes
- Moisture of tissues
- Density of tissues
- Amount of circulating blood supply
- Distance between the electrodes
- Size of the electrodes
- Tolerance of the patient
- Milliamperage employed
- Degree of temperature desired.

To sum up, always bear in mind that in the clinical effect of Diathermy Applications two factors enter: (1) the degree of heat maintained, and (2) the length of time of treatment. Also that chemical activity increases with every rise in temperature, and that pain, wherever located, is relieved due to hyperemia on the surface or deep seated.

We repeat another important point. The rate at which heat energy is developed under an electrode 2 inches square will be four times as great as under an electrode 4 inches square, that is, with the same setting of the machine. By doubling the milliampere reading, say, for example, from 500 to 1000 M.A., we actually increase the heating energy by three to four times.

A Diathermy electrode, as well as electrodes for the administering of any other electrical modality to the human body, should be of bare metal. This metal may have a backing or support of a flexible material, as, for instance, a soft rubber sponge, but the point we wish to emphasize is that the element in direct contact with the skin should be metal and not some absorbent material. Absorbent padding soaked in saline solution or other conducting medium, may be employed, but there is always danger of such electrodes drying out during the treatment and losing their conducting value. There is even greater danger of blistering by steam, and it has been found that a water-soaked electrode of, say 3 x 6 inches, which has 18 square inches of surface area, would be active only for probably 6 square inches at the end of a 10-minute treatment, the fluid having all gone to one end instead of being evenly distributed.

Medical Diathermy when properly applied should always be soothing and at no time should it become irritating to the patient.

DIATHERMY ELECTRODES

Various materials are used in the making of electrodes for the application of these currents. *Sheet Block Tin* has proven by far the most successful all-around material. It is quite flexible, depending upon its thickness, and is therefore easy to apply. It can be cut with a scissors to any shape desired, and after used can be rolled out flat and used over and over again.



The Diathermy Clamp

Such metal electrodes, as well as the surface of the skin at the point of contact, should be moistened before application. Soap lather has been applied to good advantage; we list a special paste for this purpose. Warm tap water, to which has been added a bit of sodium bicarbonate, also is excellent. Distilled water offers very high resistance to the passage of any elec-

trical current; tap water has slightly better conductivity; soap lather slightly better, Fischer Diathermy Paste still better, and sodium bicarbonate offers least resistance.

Fish Scale Mesh, when perfectly clean, makes an excellent electrode. It is easy to apply. It very readily conforms to any shape and when used with a lubricant it makes an exceedingly good contact, provided you limit the milliamperage to less than 100 milliamperes per square inch. When unclean, however, it causes hot spots. To keep this material clean have it acid dipped, and thereafter keep in alcohol when not in use.

Moist Pads such as are used for low voltage electricity are exceedingly easy to apply, but owing to the fact that the water will flow to the lowest point, dry spots will appear where the resistance will be high and the skin is sure to be burnt at such points.

Very thin, finely corrugated sheet aluminum is becoming popular. On the limbs, the electrodes are generally held from slipping with elastic bandage, wound around just tight enough to hold the electrode but not so tight that the natural swelling of the limb as a result of the heating will produce any constriction (as, for example, an ischemia). Since the regular elastic bandages are easily soiled, are spoiled by laundering, and are quite expensive, many operators make use of crepe paper bandages; these are quite satisfactory, and can be discarded after being used once.

The diathermy clamp is invaluable in many applications. Is instantly applied or removed; never short-circuits; may be used with several sizes of mesh covered sponge electrodes. A polished wood bar supports two sliding arms, also of wood, which hold the electrodes firmly in place.

Sandbags are invaluable for holding electrodes in place on the trunk, and very often on the limbs, and several sizes and shapes of sandbags should always be available in the diathermy room.

Never fail to determine the size and shapes of your electrodes, carefully. The indifferent electrode, that is on the opposite part of the body from which the greatest heating effect is desired, should always be of liberal size. There is no advantage in making your indifferent electrode small.



Sandbag

Never permit poor contacts or loose connections. Fully 90 per cent of all complaints as a result of diathermy treatments are the direct result of either improperly applied electrodes, or poor connections. A contact

that is not firm will cause a prickling, burning sensation in every instance. This lack of proper contact may be at the point where the cord connects to the machine, where it connects to the electrode, or, even between the electrode and the skin itself.

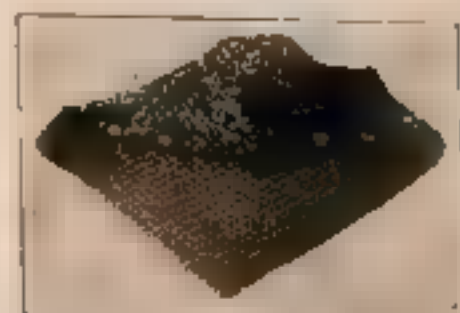
In giving diathermic treatments, the operator must use care to keep the skin surface between the electrodes absolutely dry. Soap lather, damp elastic bandages, or even perspiration will often "short-circuit" the current to a sufficient degree to produce unequal heating effects within the tissues. Warm electrodes stimulate the sweat-glands, the skin becomes moist underneath the electrodes and good contact may be established. The only requirement is that the electrode be in contact with the skin at all points, as a space underneath any part of the electrode will produce sparking and discomfort to the patient.

Current volumes, duration of treatments and frequency of treatments will depend, naturally, on the type of treatment and the nature of the case. We will endeavor on the following pages to offer some assistance along this line.

It is very important to keep the patient's confidence at all times. To that end, work carefully, slowly, and methodically, in

order to avoid making little slips; an accidental spark that to you may seem trivial, will fill the patient with terror, especially if it is a woman.

Especially, if a long series of treatments will be required, it is more important that the patient leave the treatment room after the first treatment with confidence in the doctor and in his apparatus, than that a great deal of therapeutic progress should have been made at the expense of terrifying the patient and running the risk of his or her never returning. Many operators term their first treatment a "placebo" treatment and give it for the purpose of accustoming the patient to the routine.



Flexible Mesh Electrode

IMPORTANT POINTS IN GENERAL TECHNIC IN MEDICAL DIATHERMY

1. Have your diagnosis accurately in mind.
2. Have a definite idea as to how your treatment is expected to work.
3. Decide just where the maximum heat must be applied, and arrange the size and position of the electrodes to get it there.
4. Decide whether the heating is to be mild, moderate, or intense, and plan the current intensity accordingly.
5. See that the electrodes are well lathered, and in even contact, and firmly held to the part.
6. See that the connecting wires from the machine are firmly anchored and in no danger of becoming loosened, or pulling the electrodes out of position during the treatment.
7. Begin with a feeble current intensity, and increase very gradually to the desired amount, taking several minutes to reach it. Too much spark gap makes the patient uncomfortable; too much volume from the control lever works the machine inefficiently. Balance the intensity of the current by means of both spark gap and primary control lever. The Fischer "C-D-C" machine delivers a perfectly balanced current at all settings.
8. Err in the direction of insufficient rather than excessive current until the treatment has been several times repeated. Skin burns take long to heal, leave scars, and interfere with future treatments.
9. Do not destroy the patient's confidence by careless handling of things during the first treatment.
10. Do not leave a timid patient alone at the mercy of the machine; leave an attendant on watch, or arrange a switch so that the patient can shut off the current in case something seems wrong.
11. Do not apply diathermy over enclosed gas and fluid under

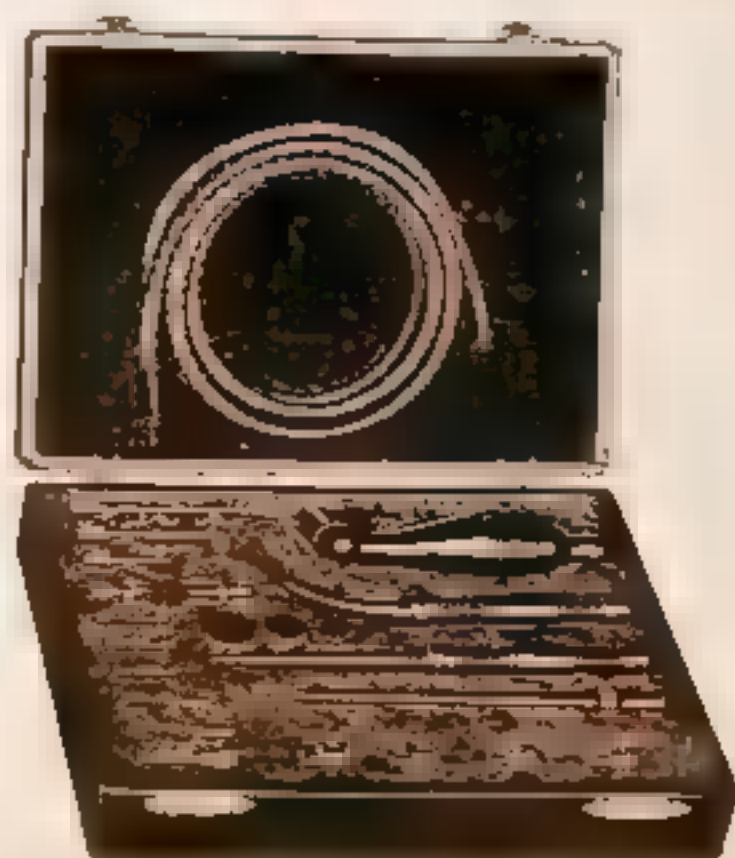
SURGICAL DIATHERMY (Electrocoagulation)

Surgical Diathermy is the term given to the application of high frequency currents for the destruction of tissues by the heat produced through resistance offered by the tissues through which the current is passed. The degree of heat is increased to dessication, coagulation, or complete necrosis, as required. Surgical Diathermy kills the tissues by coagulation of the proteins.

Howard A. Kelly, M.D., Baltimore, Md., says¹ (diathermy coagulation), "The surgical diathermy conception is as positively and aggressively surgical as the time-honored scalpel, ligature and suture, and tends largely to replace the first two—for centuries the recognized badges of our profession. The fine point of the needle forms such an admirable, delicate, controllable instrument that it makes any surgical knife seem clumsy by comparison.

"Its field par excellence is that of the malignant growth which, by and large, it covers more effectively than any other surgical method. The object is to destroy quickly by heat, within a defined area, all the suspected tissues by a perfectly controlled voltage and amperage. We are all only too well aware of the awkwardness of putting one operation on top of another in the same area at a later date, and such secondary supplementary operations are rarely satisfactory or thorough on account of scar tissue and hemorrhage. By this new procedure there is no objection to a series of follow-up operations.

"The value of this newer method is that it is quicker and more efficacious and in every way more attractive than our older procedures. It is a sort of long knife and fork manipulation which restrains the operator from direct contacts with the area under treatment. It dispenses largely with the time-honored but always objectionable ligature. With a mild antiseptic dressing the wound is cleaner and heals more quickly



*Set of Surgical Diathermy Electrodes
in Special Case*

¹J. A. M. A., May 19, 1917

and it is usually far less painful. Hemorrhage is greatly lessened and controlled by applying the current to the vessel through the pointed forceps grasping it."



*Needle Point Electrodes and Holder
(Dillinger)*

Gustav Kolischer, M.D., Chicago, Ill., says: "The superiority of the results of surgical diathermy, and the electro-coagulation of malignant tumors, is also based upon the collaboration of the reticulo-endothelial system. In the area around the coagulated structures, the so-called perithermic zone, there is always to be found an abundant invasion and neoformation of macrophages—easily demonstrable by intravital staining. These defensive cells not only attend to the particular destruction of the remaining cancer cells but are also instrumental in leading to the production of regulating ferments, bringing the riotous multiplication and intrusion of malignant cells down to a normal level."

This method differs from medical diathermy only in the fact that sufficient heat is produced to actually destroy tissue. It differs from cautery in that the heat is being electrically conducted by virtue of the resistance of the part to the flow of current applied and is not conducted inwardly from electrode due to heat conductivity.

Following this same thought, you will readily see that the temperature must be highest at the smallest electrode. Increasing the size of the inactive electrode (sometimes called the indifferent electrode) and decreasing the size of the active electrode brings about a condition where the temperature at the inactive electrode is practically normal (due to its comparatively large size) but the temperature at the small active electrode rises to the point of coagulation or, in the case of the surgical knife, to instant destruction.

In surgical work the aim is to produce concentrated heat at small areas via the needle, the knife or special electrodes of various shapes, for the immediate removal of tissue—for coagulation and sloughing, for sealing blood vessels. These can all

be accomplished with lessened danger of transplantation of bacterial elements by diathermy than any other known method. The surgical diathermy current can be used not only to destroy tissue, but also to stop hemorrhage.

Surgical Diathermy or electro-coagulation is used to advantage in malignancies, in fact it is superior to other methods in that what would be otherwise inoperable growths are successfully destroyed; the blood and lymph coagulate, the vessels are sealed and infecting organisms destroyed.

Tissues or growths to be destroyed by electro-coagulation must be accessible; that is, the active electrode must be placed in actual contact.

The major advantages of surgical diathermy, or, as we shall term it hereafter in this publication, "electro-coagulation," follow:

Tissues are coagulated to any desired depth.

Operations are bloodless and leave sterilized wounds.

The blood and lymph channels are sealed, lessening the danger of metastasis in cases of malignancy.

Tumors otherwise inoperable may be safely removed.

Speaking of these advantages, Disraeli Kobak, M.D., says: "Points of advantage as demonstrated by the experience of those familiar with this technique are: (1) Immediate destruction of the neoplastic cells in situ; (2) the carrying of the heat, by the current, to a depth in the tissue beyond that actually treated, thus assuring the destruction of any malignant cells which have been lying beyond the area which actually appears to have been involved; (3) the practical elimination of either primary or secondary hemorrhage, as the blood vessels are thrombosed beyond the area of destruction; (4) there is practically no risk of spread of metastatic elements through either the blood or lymph channels; (5) the minimum formation of contractile connective tissues."

Electro-coagulation is used to advantage in:

Destroying growths and infective granulomata of the skin and mucous membrane of the mouth, nose, pharynx, tongue, larynx and oesophagus.

Cancerous conditions—sarcoma, and carcinoma.

Destruction of diseased tissues and benign new growths.

Tumors of the uterus and bladder.

Endocervicitis.

Vascular tumors.

Chronic and malignant ulcerations.

Superficial lesions—warts, moles, naevi.

Keratosis. *Epithelioma due to disease*

Electro-coagulation is similar to medical diathermy in the fact that the application is usually bipolar. The active electrode is the small point or disc which is placed in direct contact with the diseased tissue, or the tissue to be removed, or it may be a needle, either single or multiple, or any size of small disc, fastened to an insulated handle. The indifferent electrode is usually a large metallic plate to cover a large area of skin surface (large enough so that there will be no danger of destroying healthy tissue), which is placed on the body somewhere adjacent to the point of operation.

The indifferent electrode is of sheet block tin, and should be liberal in size, preferably 8 inches square (or round), or larger.

When employing electro-coagulation the nature of the case in hand and the character of the parts involved will aid in determining whether the direct contact method as described in the foregoing, or keeping the active electrode at a distance from the growth and sparking, is desired. The latter (referred to as Fulguration) produces a rapid coagulation, but only on the immediate surface, and is preferable for small superficial lesions.

The indifferent electrode must be bound or held in the desired position in such manner that it cannot move during operation. The small active electrodes are seldom moved with the current on. When a knife type electrode is employed it may be moved slightly in the desired direction, but the tendency on the part of most operators is to proceed too rapidly, and insufficient coagulation at some point will result. Never attempt to hurry electro-coagulation. Proceed slowly and methodically and be assured of finished results, paying more attention to the blanching of the tissues than to the reading on the milliampere meter.

EFFECTS OF ELECTRO-COAGULATION

Illustration No. 1

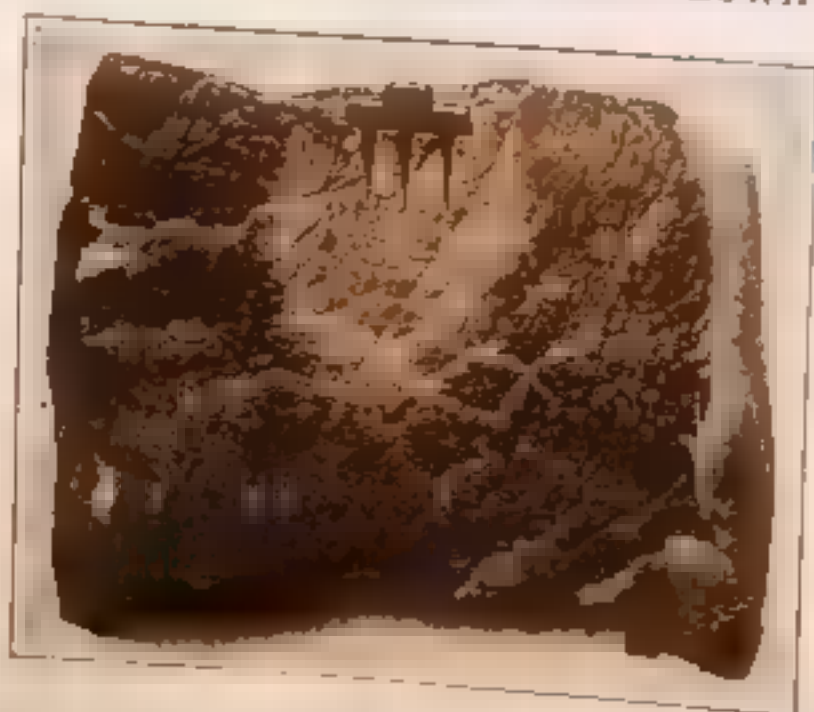
A piece of lean beef, 2 inches square and 3 inches thick, was placed on a flat metal sheet as the indifferent electrode. The $\frac{3}{4}$ inch circular disc (catalog No. 1323) was placed in firm contact with the center of the top and a current of 700 milliamperes was passed for 1 minute, followed with 1200 M.A. for another minute. Result: An evenly coagulated mass of tissue, white in appearance, extending 1 inch on the surface and $\frac{1}{2}$ inch deep. No evidence of burning or charring.

*Fig. 1**Illustration No. 2*

The $\frac{3}{4}$ inch disc was placed in contact, as above, with another piece of beef, and approximately 4000 milliamperes passed for one full minute. Result: A charred crust $1\frac{1}{8}$ inches wide on the surface, and extending down almost $\frac{1}{4}$ inch. Below this hardened section was a coagulated mass down

*Fig. 2*

another inch, tapering off in a cone shape.

*Fig. 3**Illustration No. 3*

A larger piece of beef measuring $3 \times 3 \times 2\frac{1}{2}$ inches was used in this experiment. The 5-pronged multiple needle electrode was forced down into the center until the flat section rested on the

meat proper, and 1100 milliamperes passed for $\frac{1}{2}$ minute, followed with $\frac{1}{2}$ minute of 2000 M.A. Result: An evenly coagulated white appearing mass of tissue, extending $1\frac{3}{8}$ inches deep and $1\frac{1}{8}$ inches wide. No charring.

Illustration No. 4

A piece of fresh lean beef $2\frac{3}{4}$ inches square by 2 inches deep was placed on the indifferent electrode, and the single needle No. 1308 plunged 1 inch down from the top. A heavy current 2300 milliamperes was passed for 1 minute. Result: A burned mass, charred black where the electrode had made contact, and thoroughly

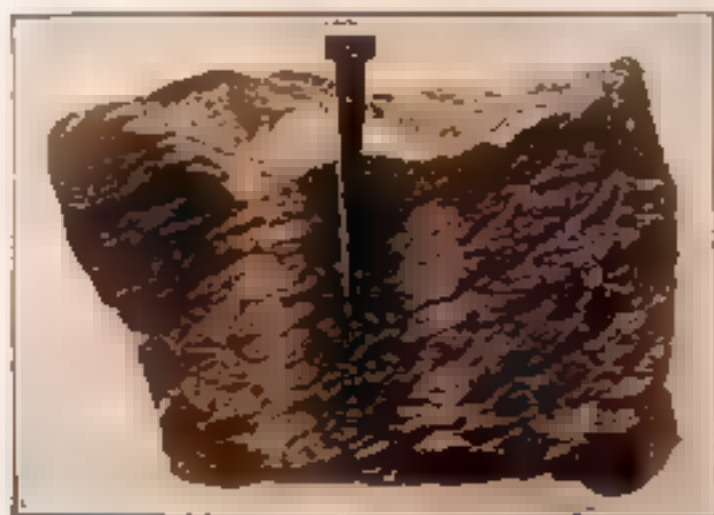


Fig. 4

usually—starting at 600 milliamperes for $\frac{1}{2}$ minute, followed with 900 M.A. for the same length of time. Result: An even coagulation, $\frac{5}{8}$ inch wide and 1 inch deep. No charring, and the line of coagulated tissue clearly defined.



Fig. 5

cooked clear through to the bottom and $\frac{7}{8}$ inch wide.

Illustration No. 5

The same size piece of beef was used as described under figure 4, and the same electrodes. Current was turned on more grad-

ELECTROCOAGULATION CAUTIONS

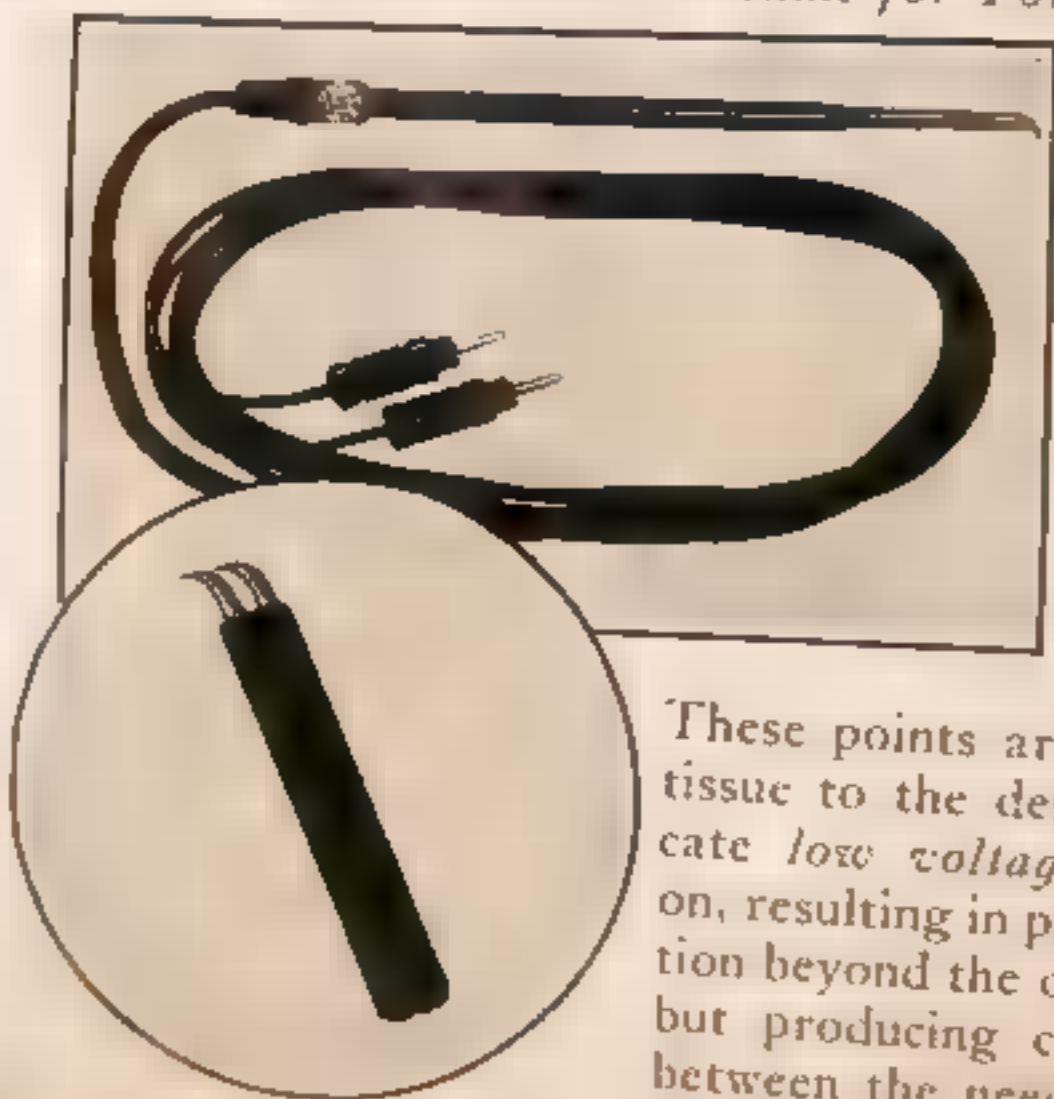
1. Be sure that the indifferent electrode is properly applied, firmly fixed so that it cannot move, and good connection made.
2. If ether anesthesia, or other inflammable gas, is used, be sure that it is a safe distance from the field of operation. Do not use a high frequency machine in the same room with ethylene anesthesia.
3. As far as practicable, avoid the larger veins and arteries when using electrocoagulation.
4. Be cautious when operating around bony structures as there is always a risk of destroying the periosteum.
5. Start every operation with the thought that too much speed may be the cause of possible failure when the operation might have been successful if more time and care had been taken.

BIACTIVE COAGULATION TECHNIC

Most minor surgical diathermy applications are made with a large inactive or indifferent electrode which is placed on a convenient part of the body near the point of operation, and a smaller flat, ball or point active electrode. The varying resistances of the tissues between these two electrodes often makes it difficult for the surgeon to properly gauge the amount of current required, and always leaves him in doubt as to the exact depth of the coagulation.

If, for example, the indifferent electrode is placed on the opposite side of the body from the seat of operation, a higher voltage is required than when the electrodes are placed nearer to one another, and it will be found much more difficult to control not only the extent in area but the depth of coagulation as well. All this has led to the present day bipolar or biactive types of electrodes. The advantages of this new type are that one may limit the coagulation to smaller areas, may exactly determine its depth, and in addition the very low voltage current required is under much more accurate control, this being especially true when supplied with a modern, delicately controlled outfit.

Biactive Technic for Tonsils



*Biactive Tonsil
Electrode*

In this newer technic two active (biactive) needles, blunt points or blades are placed closely together in one holder. In the new Biactive Tonsil Electrode these points are separated by only 2 M. M.

These points are embedded into the tissue to the desired depth. A delicate *low voltage* current is turned on, resulting in practically no coagulation beyond the outside of the needles but producing complete coagulation between the needles and to their entire depth, thereby limiting the coagulation not only to the limited area de-

sired but to the exact depth required. See pages 117, 118 for further technic.

Biactive Technic for Cervical Disorders

In the Ende-Cherry Electrode, designed for the destruction of the epithelial lining of the cervical canal, two narrow monel metal plates are mounted parallel to one another in a compressed bakelite supporting frame. This latter is very important for two reasons, the bakelite and monel metal must form a compact mass permitting perfect sterilization, and to accomplish this, tremendous pressure is required in the making of the electrode. But this is not the only important factor, the material used must be of the highest quality to prevent all possibilities of arcing across resulting in the forming of carbon on the electrode. The voltage required for the treatment is very low, making an absolutely safe application. Coagulation is produced between these blades and the depth of coagulation regulated by the time of application. The instrument is rotated back and forth with the fingers through an arc of about 180° with the fingers for a length of time varying from five to ten seconds, resulting in the lining of the entire canal being evenly destroyed to a predetermined depth. For further technic see pages 51 to 55.

Biactive Technic for Turbinates

Biactive coagulation technic is employed when applying diathermy coagulation to the turbinates. Two needles paralleling one another are mounted in a bakelite holder, and when properly applied coagulation again is maintained to a very narrow area. Several technics have been advocated for this work, but the method used by Dr. Beck and by Dr. Sinsky seem to have proven wonderfully successfully. In the method used by them, the foot-switch is used and after contact is made is depressed for a second only. Then further contacts are made above, below or posterior as the size of the turbinate may require, each one requiring but a very short application. See pages 124 and 125 for further technic.

MONOPOLAR DESICCATION

The term "fulguration" was formerly applied to what we shall refer to as monopolar desiccation. This is a dehydrating process usually employed in the removal of lupus vulgaris, warts, moles, etc.,—superficial lesions. No indifferent electrode is used; application is made from the higher voltage (unipolar) high frequency current instead of bipolar diathermy outlets.

These applications may or may not be painful depending on the depth and area of the lesion under treatment, but it is generally advisable to employ a local anesthetic. Many operators find an indirect application better than this direct monopolar treatment. The indirect method is obtained by placing a metallic electrode somewhere on the body near the site of operation, connected to the high voltage, high frequency terminal, and the pointed electrode, not insulated, is held in operator's hands.

The patient may hold a metal auto-condensation handle firmly in both hands to make connection to the proper outlet on the machine, but the resistance of the wrists and arms must be taken into consideration and more current employed than where the plate electrode is placed closer to the point of contact of the active electrode as first described.

Another indirect method, bipolar instead of monopolar, is obtained by connecting the auto-condensation pad or cushion to one of the diathermy outlets, and the active electrode to the opposite diathermy pole. The patient may either sit or recline on the pad or cushion, and the active electrode is held in an insulated holder in the operator's hands. Application to the growth or lesion is made exactly as described under the indirect method, but sparks will be shorter, hotter and more caustic, because more milliamperage is obtained by this method. This method may be used for actual coagulation procedure.

The needle or pointed electrode is held firmly in the operator's fingers and may either be placed in contact with the spot to be removed before the current is turned on, or the current turned on first and the needle then applied.

When employing the indirect method, current goes from the patient to the needle in the operator's hands. The amount of current is limited by the capacity of the operator. The application is less painful than the direct method; the operator will feel no sensation of currents, no ill effects will result, but the penetration will be less than when employing the direct method. This is the method of choice in treating moles and naevi.

Do not touch your patient during a treatment, as the shock at the point of contact will be disagreeable. Be sure that you use a wooden chair or wooden table. Never place the auto pad in contact with metal. You will find from experience that you will be able to pass a great deal more d'Arsonval current through a



Auto-condensation Couch Pad

stout patient than through a thin one. This is just the opposite of the effect obtained in administering medical di-

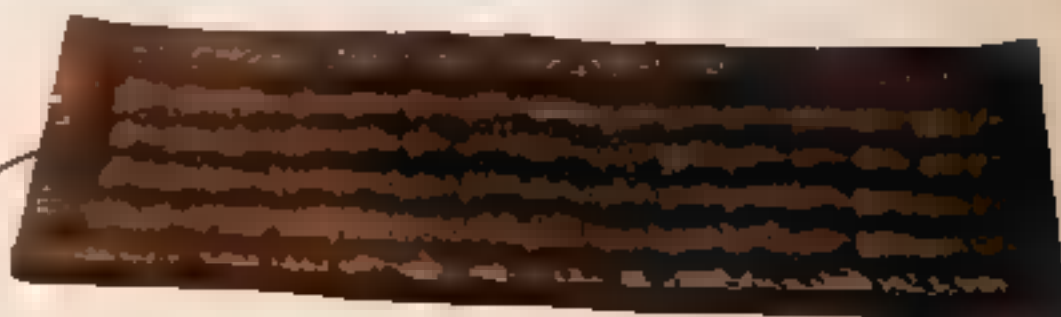
thermy, as an obese person will take less diathermy milliamperage at a given setting of the controls on the machine than a thin one.

You should always recommend that your patient drink a great deal of water during a series of auto-condensation treatments. See that he drinks a glass of water immediately preceding each treatment. One of the most important features of an auto-condensation treatment is that your patient must be fully relaxed and made just as comfortable as possible.

Patients with exceedingly high blood pressure, and with a slow pulse, should be carefully watched during and after treatments.

The treatment of hardened arteries, walls lined with calcareous deposits, must be undertaken in a systematic way if lasting results are to be obtained. To lower the blood pressure too suddenly in these conditions is very dangerous.

During the menses it is inadvisable to use any high frequency treatments, but on the contrary, in cases of suppression, auto-condensation may be used as a stimulant.



Auto-condensation Couch Cushion

It is well to place the patient's hands on a pillow or large book when using a metal handle, in this way keeping the hands away from the body proper so there will be no danger of sparking. Caution your patient not to drop this metal handle with the current on, or even relax the hold, as resulting sparks will be sufficient to cause a severe burn.

Do not use auto-condensation in advanced arteriosclerosis or in extreme old age.

HIGH FREQUENCY

High frequency vacuum and non-vacuum electrode applications are not as widely used as in the past because the effect is only superficial as compared to the far deeper auto-condensation and diathermy treatments. However, high frequency electrode applications are quite clearly indicated in infectious skin diseases, as well as infections in the orifices which can be reached with the electrodes.

High frequency currents:

Dilate the blood vessels
Increase local blood supply
Increase oxidation
Increase elimination

Increase lymph circulation
Promote absorption of exudates
Liberate ozone

These applications are used in the treatment of:

Skin ulcers
Local debilitated conditions
Localized edemas
Painful localized conditions

Blepharitis
Lambago
Uterine disease
Tonsillitis

When the glass vacuum electrode is properly connected to the high frequency terminal on your machine, that is, with the aid of the proper handle and conducting cord, and the switch closed, it does not always illuminate with the familiar violet colored glow.

If current does not immediately pass thru the electrode, grip the glass with the bare hand to warm it, or increase a bit the volume of current passing.

When an electrode becomes what we might term "stubborn" and will not light up, shut off the machine, leave the controls as they were but remove the heavy cord from the active pole and remove the electrode from the high frequency handle. Hold the electrode firmly in the bare hand. Start the machine and then touch the glass electrode itself to the active post, and unless the tube is punctured or otherwise defective, it will glow properly. Then shut off the current, connect the cord, handle and electrode to the machine as before and you should have no further trouble.

* * * * *

Metallic electrodes directly connected to the diathermy current are far more effective and will produce better results than the glass vacuum tubes.

Vacuum electrodes do not administer ultra-violet rays to the patient.

There is no such thing in physiotherapy as a "Violet Ray."

DIATHERMY THERAPY

An Alphabetical List of Indications and Treatments

ADHESIONS

Adhesions, if not too old and involving the larger ligaments, can be handled to advantage with diathermy. 20 to 30 minutes every day, or at least three times a week, with current to patient's tolerance, is advised. Such treat-



Application of Electrodes in Adhesions



Adhesions—Massage

favorably influence muscular spasms (peristalsis). The treatments should be mild, an average of 600-1200 milliamperes being sufficient.

ment may be followed to advantage with sine wave.

While diathermy cannot be expected to remove organized adhesions, especially fibrous bands usually encountered in the abdomen, or pleuritic adhesions of long standing, this agent will, in the majority of instances, relieve the pain and

ADENITIS, CERVICAL.

Indirect diathermy is the method of choice in Adenitis. The patient is placed on the auto-condensation pad, which is connected to the highest voltage post of the machine, and treatment is given by the indirect method, the operator using his fingers for the other electrode. Diathermy should not be applied if suppuration is pent up. X-ray treatment and ultra-violet are valuable aids

ADENITIS, INGUINAL

See Buboes, p. 40

ADNEXITIS

Martin S. Sichel, M.D., Portland, Oregon, in discussing the use of diathermy in pelvic infections, says, "Ditmer in 1921 reported the largest series of cases treated by diathermy. Of 937 cases treated, he reports anatomic restoration of the adnexae in 372, or 39.4 per cent; subjective cures or improvement in 447, or 47.3 per cent; while 115, or 12.1 per cent, were improved. Cumberbatch and Robinson in England report forty-one cases of adnexitis with pelvic masses treated by diathermy. Thirty-three, or 80 per cent, completely recovered; six were partially relieved or relapsed, and two were unrelieved."

ALBUMINURIA

Albuminuria being a general term, diathermy is applicable only when indicated by the cause or pathologic condition involved. In functional (cyclic) albuminuria, of course, diathermy has no direct indication. In the renal forms diathermy has a distinctive therapeutic value.

When due to nephritis with hypertension, autocondensation treatments are indicated. From 500 to 600 M.A. for 20 to 30 minutes. In cardiorenal conditions with edema, it is advisable to treat over the liver and kidneys, employing about 1,000 M.A. for 30 to 40 minutes. In this condition diathermy may also be applied across the thighs. This general diathermy application will increase the red blood count very perceptibly. Long narrow electrodes measuring about 3x7 inches, are placed on opposite sides of the thigh, either laterally or A.P. Just a moderate amount of current (from 500 to 600 M.A.) should be given daily or at least three times a week for about thirty minutes.

AMENORRHEA

See Diathermy in Gynecology, pp. 70 to 74.

Diathermy to the female pelvis is indicated in this condition, preferably with the Chapman vaginal electrode. The following technic has been described in above article, but do not use excessive milliamperage. About 1,500 milliamperes is sufficient. The treatments should be given about three times per week, and supplemented by general irradiations from the air-cooled ultraviolet

lamp, and by the administration of a ferruginous tonic and arsenic. Calcium and phosphorus are also useful in the treatment of this condition. If intra-vaginal treatments are contra-indicated, because of unruptured hymen, etc., a mesh or block-tin electrode may be applied anteriorly above the pubis and posteriorly over the sacrum with satisfactory results.

ANALGESIA

As a general proposition diathermy should not be used in any condition marked by an impairment of the sensory nerves. On account of the inability of the patient to experience pain, diathermy in conditions associated with analgesia is contra-indicated, as a severe burn might result.

ANEMIA, SECONDARY

Diathermy to the long bones is a useful adjuvant to other methods of treatment.



Left — Application of Electrodes in Anemia



ANKLE, DIATHERMY TO

At Left—Cuff electrode above ankle, foot immersed in basin containing $\frac{1}{2}$ in. of water in which other electrode is inserted. Elastic bandage being applied.

Indications: All painful or inflammatory conditions of foot and ankle.

ANKLE, DIATHERMY TO

At Right—Treatment of ankle by diathermy, using two electrodes, one on either side of ankle, held in place by elastic bandage. 700 to 1000 milliamperes for 20 to 30 minutes.



ANEURYSM

Diathermy may be employed to relieve pain caused by an aneurysm, but has no direct effect on the course of the disease. Dr. W. W. Blackman of Atlanta, Ga., states¹ in commenting on an interesting case report, that diathermy treatments relieved the severe attacks of pain. The lowest voltage that will produce a smooth-flowing current across the spark-gap should be used, and the amperage raised cautiously. Some men claim that 100 milliamperes is sufficient while others use as high as 1200. The physician should not entrust this treatment to an assistant, but should keep in constant touch with the patient during treatment. Electrodes of approximately the same diameter as the depth of the tissues to be traversed should be used. Treat ten to twenty minutes.

ANGINA PECTORIS

Careful diet and abstinence from all undue exertion are important. During the paroxysms it is essential that the spasm and constriction be controlled. The medication generally favored is nitroglycerine in large doses. Diathermy directly to the affected region is excellent, and may be employed two or three times a week as a preventive, as well as in emergency. Use large block tin electrodes directly over the heart and on the back. Employ the minimum dosage that will give relief, 400 to 1000 M. A., for 10 to 12 minutes. Ultra-violet radiation also is indicated.

ANGIONEUROTIC EDEMA

Medical diathermy has proved valuable in the treatment of this condition. The treatments should be given daily and the amperage elevated to skin tolerance. Treat for from twenty to thirty minutes, using large block tin or mesh electrodes.

ANKYLOSIS, FIBROUS

Apply diathermy by means of half-cuffs above and below the joint, or directly through the joint, followed by massage.

ANUS, FISSURE OF

Walter Zweig says² "Diathermy is used in a large number of cases of deep fissures, and since the use of this kind of therapy was introduced, there was never a need of surgical interference. Diathermy can be given in the office to ambulatory patients. After-treatment is unnecessary, so patients can continue to follow their vocations. It is not possible to indicate a current which is

¹ *S. Med. & Surg.*, Nov., 1922.

² *W. J. H. K. J.*, W. J. H. K. J., Jan., 1927.

applicable to all cases. This must always be determined for each case. But at all times the treatment must be begun with very small currents.

"It is interesting to note the almost complete anaesthesia of the mucous membranes treated with diathermy. This anaesthesia of the treated parts causes complete stoppage of the sphincter spasm which is the main cause of the difficulty to cure an anal fissure. Another observation shows that the wounds treated with diathermy require an abnormally long time for epithelium reformation. The wound is not healed before 4 to 6 weeks. But there is no objection to this slow healing since the patient does not feel any pain."

According to H. A. Kelly and G. E. Ward^{*} surgical diathermy methods are efficacious in the treatment of pruritis ani, fissures, fistulae, external and internal hemorrhoids, and rectal polyps. The healing following destruction of diseased tissues with high frequency electric currents is usually prompt and with little or no pain. The operations are almost bloodless and are most frequently performed under local anesthesia.

ARTERIO-SCLEROSIS

Diathermy, combined with the general treatment, may be used to advantage, especially in the early stages. The patient is given autocondensation treatments of 20 to 30 minutes duration, daily, lying on the autocondensation pad and holding the autocondensation handle. The current is advanced very gradually to 300 milliamperes; do not exceed this until you are sure the patient will react favorably to more. Under favorable conditions as much as 700 milliamperes may be given. At the conclusion of treatment, the current is shut off very slowly. Contraindications are hypotension, low systolic and high diastolic pressure. Be cautious about lowering the blood pressure too rapidly in these cases.

ARTHRITIS

Unquestionably the most important feature of the diagnosis and treatment of any case of arthritis is the discovery and the removal of the underlying causes.

The acute stage frequently follows exposure to cold and dampness, and these conditions are sometimes erroneously accepted by the patient as the cause of the disease. As a matter of fact, they have merely served to bring the trouble to a focus.

^{*}Int. Jour. Med. & Surg., 41, 3.

ATONY

Medical diathermy is indicated in the treatment of impoverished tissues, however, if there is an impairment of the sensory nerves, great care should be exercised to prevent burning. The main value of diathermy lies in its effect on the vascular system. Freshly oxygenated blood is drawn to the part and the metabolic exchange proceeds more rapidly. Treat thirty to sixty minutes daily, using just sufficient current to produce a pleasant sense of warmth within the tissues. Apply electrodes as in Arthritis, (pp. 33, 34).

AUTO-CONDENSATION

For auto-condensation treatment for hypertension, the patient lies supine on the auto-condensation pad, which pad is connected to one terminal on the diathermy machine, and grasps the large metal handle which is attached to the other diathermy terminal. The patient's position is illustrated below. Remove any of the patient's clothing that may contain metal fastenings. During treatment, the patient's hands should be supported on a small pillow, to prevent sparking.

Below—Auto-condensation for high blood pressure. Pressure is being taken at intervals as treatment progresses. Bipolar current, 600 milliamperes for 20 minutes. Treat daily. In the presence of heart and kidney complications the auto-condensation treatments are often not borne well by the patient. The physician should keep in constant touch with his patient during the treatment, and not leave these cases to the care of an inexperienced technician.





AUTO-CONDENSATION—Cont.

At Left—Recently reports are had of physicians obtaining satisfactory results by substituting a 7 in. by 9 in. metal electrode over the chest for the hand electrode. 300 to 700 milliamperes for 20 minutes.

At Right—In hypertension associated with chronic interstitial nephritis, beneficial effects may be obtained by placing the patient prone on the auto-condensation pad, and a 5 in. by 7 in. metal electrode held in place by sandbags, over the kidneys. 500 to 750 milliamperes for 20 to 30 minutes.



AUTO-CONDENSATION—Continued

At Right—Pleasant auto-condensation treatment for the neck. Patient seated on pad, other pole of bipolar current passing through operator's fingers to neck.

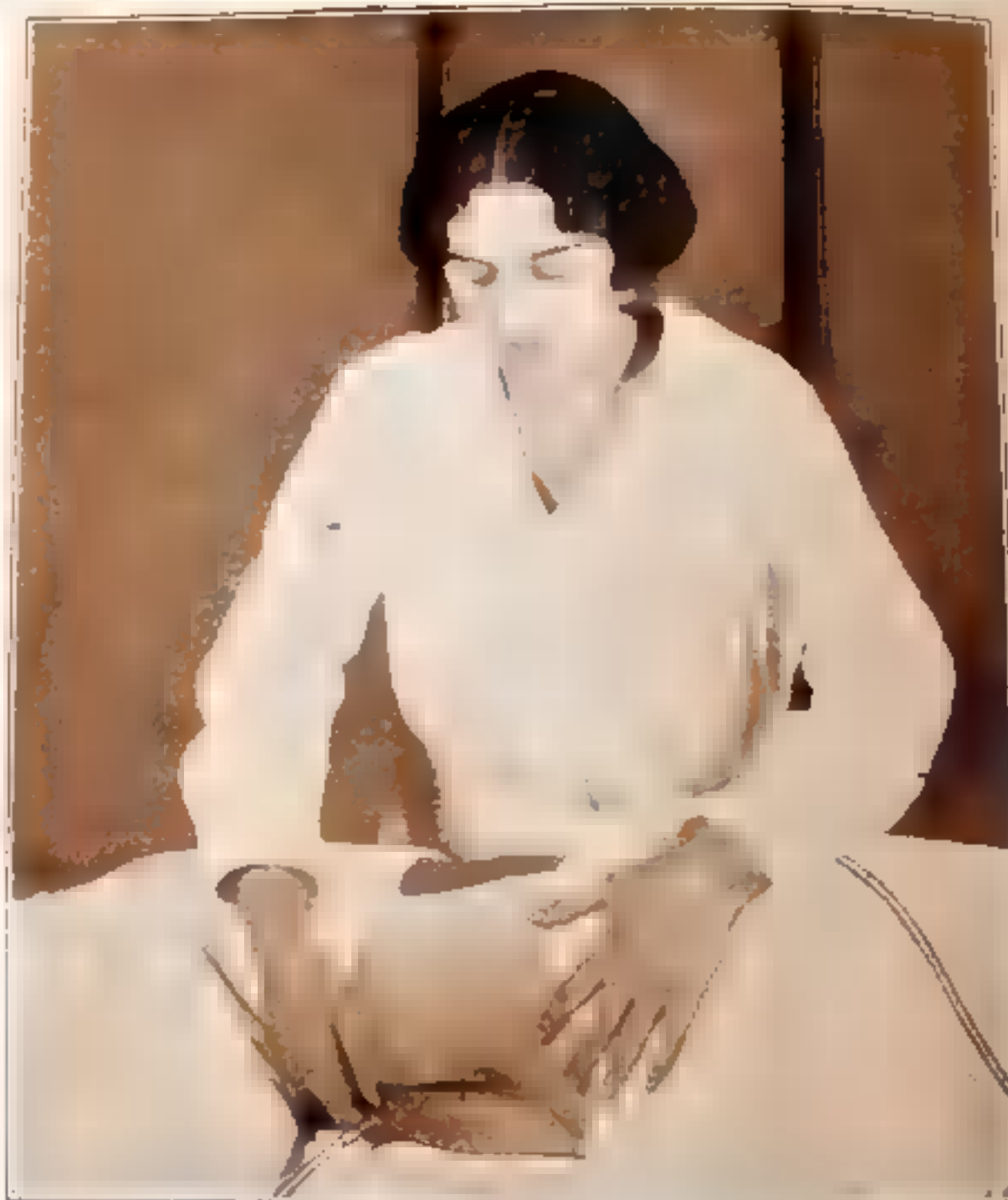


BACK. DIATHERMY TO

This treatment is of great value in spasticity and rigidity of the muscles of the back, or in fact for spasticity or rigidity of any muscles. Not only will these abnormal conditions be overcome by the application of diathermy, but the pain and tenderness attendant upon these conditions will soon be remedied.

It is good practice to apply mild surging sinusoidal treatment or hand massage to the affected muscles after the application of diathermy. It will be noticed that the tenderness on pressure that the patient complains of before the treatment, is practically eliminated after the first treatment. If there is any return of the tenderness in the forty-eight hours following the treatment, it will be nothing in comparison to what existed before.

BACK, DIATHERMY TO—Continued



The illustration shows how two large mesh electrodes are placed over the abdomen and under the back, with the larger one on the abdomen. Bipolar current to patient's tolerance for 20 minutes.

BLADDER TUMORS

Howard A. Kelly and William Neill, Jr., speaking of electrocoagulation say¹¹ that they believe that this method affords an extraordinary facility for dealing with tumors of the bladder without an incision, through the open cystoscope, in the male as well as in the female, and that in this way it will be possible to desiccate the bases of all pedunculate tumors and destroy them as a rule at a single sitting. Such a procedure simply calls for dexterity in the use of a cystoscope and in introducing a long well insulated needle to be brought into contact with the base of the tumor or to be plunged into it.

¹¹ Urol. & Cut. Rev.

BRAIN AND SPINAL CORD. CHRONIC DISEASES OF

F. Kraus says¹⁵ that diathermy not only has the effect of producing hyperemia and absorption, of alleviating pain and killing bacteria, but it also stimulates the functional activity of the organs.

A striking improvement in central paresis of the extremities has, for instance, been observed during diathermy treatment of the corresponding segment of the spinal cord. Sagittal diathermy of the head stimulates the function of the diuretic center in the midbrain. The increase of diuresis reaches its climax 24 hours after diathermy treatment.

As is demonstrated by the histories of 14 patients, striking results have been achieved in 15 to 20 sittings by diathermy of the head, as intensive as possible, but at fairly long intervals (application of electrodes according to choice, no risk involved) especially in cases of post-encephalitic shaking tremor, tic douloureux, encephalitis lethargica, paralysis agitans, chorea minor and in spastic hemiplegia of various etiology (diphtheria, apoplexy, etc.).

BRONCHITIS, ACUTE

See Pneumonia, pp. 98 to 101—technic is same.

BRONCHITIS, CHRONIC

Chas. E. Stewart, M.D., says¹⁶ that diathermy is of value in bronchiectasis and in chronic bronchitis. The agonizing paroxysms which characterize bronchial asthma are frequently relieved by the use of diathermy to the chest.

Make sure that the condition is not one of incipient tuberculosis. Diathermy treatments should be given through the region of the affected bronchi. Treatments should be mild, long, frequent, and continued. Also treat the patient's general condition by diet, rest and tonics.

Electrode of block tin 6x8" over the upper dorsal spine, and a small electrode about 5x6" over the affected area anteriorly. Start with short treatments—not over 15 minutes—of about 500 M.A., and this may be increased later to as much as 30 minutes.

¹⁵ Medizinische Klinik, No. 50, '29.

¹⁶ Am. Jour. Phys. Ther., Jan., '27.

BUBOES

Diathermy may be used to good advantage in an effort at aborting the progress of the inflammation. Failing in this it may still further be employed to hasten resolution by bringing an oversupply of blood to the inflamed glands. Treatment should be discontinued at the first sign of softening or suppuration, and the pus evacuated. Radiant and ultra-violet light should be used for subsequent treatments.

Dose of diathermy is moderate tolerance for the patient for thirty minutes daily. The active electrode should be applied directly over the inflamed gland and should be slightly larger than the area to be treated. The indifferent electrode should be large and should be placed as nearly opposite the active electrode as possible.

BURSITIS

Diathermy applied daily, followed by gentle massage and manipulation, furnishes a form of treatment from which one may confidently expect prompt relief from the pain and normal restoration of function within 2 to 3 weeks.

It is best to give very moderate treatments only for the first few days. In chronic bursitis longer treatments running up as high as 25 minutes, may be employed.



If only a moderate amount of fluid is present, absorption quite readily takes place. If absorption does not occur it should be aspirated under strictly aseptic conditions.

Following treatment, as in a knee or elbow, the part should be snugly bandaged with an elastic bandage.

*Showing use of Diathermy Clamp
in applying Electrodes to Knee*

CANCER

It is held by most physicians and surgeons that cancer is curable in most cases when discovered before metastasis has occurred. The danger of metastasis is much less when Diathermy is used than in operations with the knife, since diathermy seals the blood vessels and lymphatics, thereby lessening the chance of spreading the malignancy at the time of operation.

Surgical diathermy is the method of choice of a very large number of surgeons in the treatment of cancerous growths. Among its advantages are accuracy of control, immediate relief of pain, thorough and immediate sterilization of the wound, absence of shock, practically no hemorrhage, little danger of secondary hemorrhage, much less danger of extension and metastases than in use of the knife. Small lesions are removed quickly and painlessly by this method; in large operable lesions it has all the advantages mentioned above: inoperable cases, so-called, surgical diathermy permits the surgeon to operate in otherwise inaccessible locations, and in cases of extensive vascularity and involvement where the sealing of lymphatics and blood vessels is essential.

George M. Wyeth, M.D., of New York, says that the advantages of diathermy are (1) Decreased danger of metastasis and likelihood of recurrence. (2) Alleviation of pain. (3) Practically no hemorrhage. (4) Practically no surgical shock. (5) Accuracy of dosage; current under absolute control of operator. (6) Sterilization of wound incidental to treatment. (7) Patient's postoperative condition generally satisfactory leading to quick recovery and good cosmetic result.

J. Thompson Stevens, M.D., Montclair, N. J., says,¹⁷ "As compared with excision, diathermy coagulation has the enormous advantage of destroying the malignancy before it is removed. It is impossible to overestimate the value of the fact that with this method the growth is removed as a dead mass instead of as a mass of viable cancer cells."

Joseph K. Narat, M.D., Chicago, Ill., says,¹⁸ "Surgical diathermy sterilizes the zone of potential invasion about the original site of the tumor and decreases the possibility of dissemination of malignant cells. The degree of destruction and the depth of penetration of the electrothermic energy can be regulated with great exactness. Hemostasis is secured easily, as the

¹⁷ *Phys. Ther.*, June, '28.

¹⁸ *Arch. Phys. Ther.*, N. Y. Rad., Jan., '28.

bleeding vessels are sealed with the electrode. No suturing is required."

H. H. Bass, M.D., Durham, N. C., says,¹⁹ "The chance of a metastasis developing from the operation is negligible. The cancerous mass is first surrounded by a coagulated circle, extending well into healthy tissue to the depth desired. Scissors are used in this coagulated circle to separate the healthy from the diseased tissue. After this is done, the lesion is thoroughly coagulated and removed by curet and scissors. It is well to coagulate the crater superficially to control hemorrhage. The operation is best done under a general anesthetic. The operation can be stopped and the anesthetic readministered until the work is completed. The remaining coagulated tissue will separate and can be removed in about one week, bone will sequestrate and is ready for removal in about six weeks.



Fig. A

CAULIFLOWER EPITHELIOMA

Successfully removed by surgical diathermy. Illustration A shows side view of the growth; B, same patient after operation showing wound healed.



Fig. B

Treatment of Cauliflower Epithelioma

The large indifferent electrode is attached firmly to the back, between the shoulders. Use local anesthetic, one-half of 1 per cent novocaine solution to which is added 1-1000 adrenalin solution. Active (needle) electrode is placed in contact with the tissues and current turned on. As tissue blanches, needle is pushed slowly forward in the tissue until destruction has occurred to the desired depth. Current is then turned off, the needle removed, and adjacent areas similarly treated until the operation is completed. Milliamperes, 700 to 2500, to be gauged by size of the lesion, tissue resistance and current delivered by the individual machine. Indications, all epitheliomata. Contra-indications, none. After-treatment, sterile dressings, X-ray or radium therapy, actino-therapy.

¹⁹ Arch. Phys. Ther., X Ray, Rad.



SKIN CANCER

The above illustration on the left shows a small skin cancer treated by "cancer paste," resulting in severe skin necrosis and rapid spreading of the process. The right illustration shows the same patient completely healed following treatment by surgical diathermy.

Treatment

Surgical diathermy used to remove malignant tissue, technique as described on preceding page. Also X-ray, skin cancer dosage, and actinotherapy, 3 to 10 minutes daily.

CANCER OF THE TONGUE

W. D. Harmer points out² that diathermy has now been in use in the treatment of cancer of the tongue for about seventeen years. The results that have been reported by surgeons in all parts of the world are so encouraging that there can be no doubt it is one of the best methods of treatment that has so far been devised. If the operation is properly carried out by the bloodless method there is no danger of disseminating the growth. Certainly it is easier to operate by this means than with the knife. The treatment can be carried out in a shorter time, and there need be no handling of the tissues. Complications are also less frequent than after cutting. Thus there is less shock and toxemia. The absence of pain is remarkable, and allows of easier swallowing. The sloughing that results is harmless. Many cases which would be considered inoperable by ordinary means can be relieved, if not cured, by the method—in fact, it may be the only means of sterilizing a painful septic sore. Even where life is not prolonged, the existence of the patient may be rendered more bearable.

² Brit. Jour. Surg., 15, 60.



CARCINOMA

Above, at left, destroying cancerous tissue by surgical diathermy, under chloroform anesthetic. Above, at right, fulguration of cancer (using electro-cautery). Below, illustration of large cancer developing in left mastoid region.

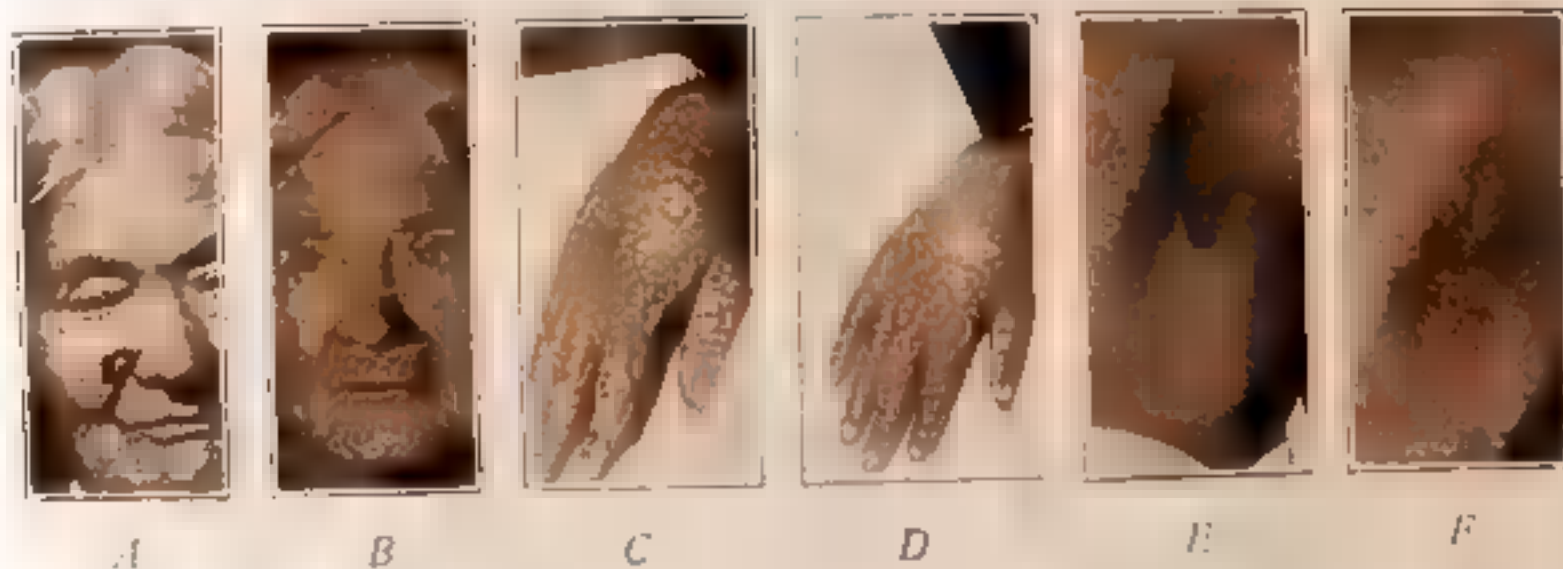
Treatment

Fulguration and surgical diathermy, large indifferent electrode attached firmly to back, suitable small active electrode from Fischer Electrode Set. Anesthetic, chloroform. Milliamperes, 700 to 2500, depending on size of lesion, resistance of tissues and machine used. Post-operative treatment, X-ray and sterile dressings. Duration of post-operative treatment, indefinite. Indications, all accessible malignant growths. Contra-indications, none.



CANCER, PHARYNGEAL

D. McKenzie,²¹ advocates diathermy in the treatment of both eradicable and ineradicable pharyngeal cancer. Its value lies in its double action of cauterizing and coagulating the diseased tissues, with a sterilizing effect upon the surrounding tissues. In dealing with a limited cancer the primary deposit should be removed by diathermy and the lymphatic glands by combined dissection and diathermy, the intervening tissues being treated by diathermy puncture. While this can be done at one sitting McKenzie thinks it is better to divide it into two separate operations. In ineradicable conditions bold and wide diathermy of tissue will prolong life, and the glands after diathermy puncture may shrivel and disappear.



EPITHELIOMATA

Illustration A, epithelioma near ala of nose; B, after treatment by surgical diathermy. C, epithelioma of dorsum of hand; D, after treatment by surgical diathermy. E, epithelioma in axillary region; F, after treatment by surgical diathermy.

Treatment

Electro-coagulation by diathermy current, large indifferent electrode attached firmly to back, suitable needle electrode for active electrode. Local anesthetic, one-half of 1 per cent novocaine solution, to which is added 1-1000 adrenalin solution. Milliamperes, 700 to 1500 or more, depending on size of lesion, tissue resistance and machine used. Technique as on page 16. Indications, all epitheliomata. Contra-indications, none. After-treatment, sterile dressings, X-ray or radium therapy, actino-therapy.



A



B



C



D



E



F

CANCER OF THE BLADDER

The above six illustrations show the various steps in this operation as performed by Gustav Kolischer, M.D., Michael Reese Hospital, Chicago. Detail of Dr. Kolischer's technique given below.

Treatment

Inert electrode, block tin, 20x10 cm., fastened under hips. Barnes bag inserted into rectum and distended by 200 c. c. of water, raising trigone and facilitating clearance of vesical base. Usual median abdominal incision exposing anterior aspect of bladder; reduplication of peritoneum stripped off by gauze dissection, exposing freely the outer anterior bladder wall. Then in the upper and lower angles of the wound two tension sutures are inserted which penetrate the bladder wall. The ends of the sutures are secured by metal clamps, whose weight helps to elevate the bladder, which in later stages makes the vesical cavity better accessible. Now the bladder is opened between these guy ropes by a transverse incision (illustration A). The transverse incision, while permitting free exposure of the vesical interior, offers the advantage of facilitating the suture of the bladder wound and at the same time prevents oozing of urine into the cavum recti, in case the suture line should give. Then in the upper and

lower angle of the vesical incision a fiber retractor is inserted. If one encounters an arboraceous bushy tumor, an electrode carrying 3 or 4 spikes is chosen, and by raining a shower of heavy sparks all over the crown of the tumor (illustration B) a superficial coagulation or carbonization is accomplished. If the tumor is pedunculated, its seared top is seized with forceps and gently pulled upward. The exposed pedicle is now severed with a galvanocautery closely to its implantation (illustration C). The resulting stump and the immediately adjacent area are now coagulated with a stamp-shaped electrode (D). The sideration and coagulation are carried on until a thoroughly dry scab results and no punctuate oozing is to be seen. The bladder is now mopped clean and the incision in the bladder closed by catgut sutures inserted in such a way as to guarantee a broad apposition and avoidance of impaction of the mucosa into the suture line (E). Over this suture a simple running suture is whipped to insure water tightness. Then the tension sutures supporting the abdominal wall are placed. Underneath these sutures a fine drainage tube, preferably of silver, is placed, parallel to the incision and protruding at each end of it (F). Then fascia and cutis are closed in the usual way and the guy ropes are tied. The patient either begins to urinate naturally shortly after the operation or if unable to do so is catheterized at regular intervals until natural function is resumed. Beginning at the end of the first week after the operation as a matter of extreme precaution the bladder is regularly irrigated with an antiseptic solution.

CANCER OF THE MOUTH

William L. Clark, M.D., says,²² "Electrothermic methods are peculiarly adapted to the treatment of cancer within the mouth. Malignant tissue (including bone) occurring in any part of the oral cavity, comprising the lips, buccal surface, tongue, floor of the mouth, alveolus hard palate, antrum, tonsils, pharynx, epiglottis, larynx, and proximal end of the oesophagus, may be destroyed with one electrothermic operation."

Wyeth expresses confidence²³ in surgical diathermy as a treatment for the removal of malignant lesions of the oral cavity, and his belief that better results will be achieved in the treatment of all neoplasms when surgical diathermy is employed in the beginning in all those cases to which it is applicable. His conclusions are based on the record made by the method over a period of five years, a record made on patients referred for treatment in many instances after surgery and physical measures had failed.

²² J. A. M. A., 71, 17.

²³ J. A. M. A., July 10, 20.

CANCER, INOPERABLE--PALLIATIVE TREATMENT OF

Joseph K. Narat, M.D., Chicago, says," "Surgical diathermy proved to be a very efficacious agency in the treatment of accessible inoperable neoplasms.

"The sealed blood and lymph channels guard against induction of metastases. Even in advanced, hopeless cases formation of metastases is undesirable because they may be source of great pain and impair the function of the involved organ and thus shorten the life of the patient. Surgical diathermy sterilizes the zone of potential invasion about the original site of the tumor and decreases the possibility of dissemination of malignant cells. The degree of destruction and the depth of penetration of the electrothermic energy can be regulated with great exactness. Haemostasis is secured easily, as the bleeding vessels are sealed with the electrode. No suturing is required."

For further discussions of various phases of Surgical Diathermy in cancer, see the following.

Steward, F. J.:—Diathermy in Treatment of Malignant Disease. *Practitioner* 108:328, May, 1922.

Kolischer, G.:—Surgical Diathermy and Radio-therapy in Cancer of Uterus. *Surg. Gynec. Obstet.* 35:227, Aug., 1922.

Patterson, N.:—Diathermy for Malignant Disease of Mouth, Pharynx and Nose with Notes on 17 Cases. *British Med. Journal* 2:56, July 14, 1923.

Wyeth, G. A.:—Endothermy in the Treatment of Accessible Neoplastic Disease. *Annals of Surgery*, 79:9, Jan., 1924.

Kowarschik, Josef (Berlin, Germany):—Surgical Diathermy. *The American Journal of Physical Therapy*, May, 1930.

Harner, W. D.:—Diathermy for Cancer of Tongue. *British Journal of Surgery* 15:60.

Narat, Joseph K.:—Palliative Treatment of Inoperable Carcinoma. *Archives of Physical Therapy, X-ray, Radium*, Jan., 1928.

Pass, H. H.:—High Frequency Currents in the Treatment of Cancer. *Archives of Physical Therapy, X-ray, Radium*.

Kolischer, Gustav:—Diathermy in Cancer Therapy *Archives of Physical Therapy, X-ray, Radium*.

Schmidt William H.:—Electrothermic Methods in the Treatment of Inoperable Cancer of the Breast. *Archives of Physical Therapy, X-ray, Radium*, Jan., 1928.

Ward, Grant E.:—The Present Status of Electrosurgery. *Am. J. Surg.*, 6:2:232-3, Feb., 1929.

CARBUNCLE

If the focus of infection is near the surface of the skin, electro-desiccation or even electrocoagulation is indicated.

CARDIAC DECOMPENSATION

A. F. Tyler, M.D., Omaha, Nebr., says,²⁵ "Treatment was given with diathermy through the liver daily. The medical regime was also continued. After the third treatment improvement was noted and after twenty-one treatments the edema had disappeared and the ascites had been absorbed. During the same time the liver decreased to its normal size and the heart became compensated. Within a month from the beginning of treatment the patient was able to be about the room."

CARDIAC DISEASE

Dr. Justina Wilson says,²⁶ "We know that, by Joules' law, whenever the diathermy current passes through the body, deep heat is produced by the resistance of the tissues. The effect of such deep heating means a better flooding of the tissues with arterial serum, better resorption of pathological products, relief of pain and increased circulation. Diathermy is extremely helpful in many cardiomuscular conditions."

Curran Pope, M.D., describes his treatment as follows:

Rest and exercise in alternation very valuable. Resistive exercises, walking and the use of the "stairs," enables accurate prescribing. Exercise improves the heart, if properly used. The ice bag, concussion of the spine, carbon dioxide baths or the author's method of using the apparatus of the whirlpool bath instead of CO₂ may be employed.

Diathermy is one of the very best of all the physical measures. I prefer large doses for shorter periods. Gradually work up to giving 1000 to 1500 milliamperes for 10 to 20 minutes. Heavy persons, those with large chest boxes, require more current and a larger period than thinner individuals with flatter chests. The anterior electrode should be smaller than the posterior. Diathermy is more active when combined with other physical measures and internal medication.

CARDIOSPASM, TREATMENT OF

Martha Brunner-Ornstein reports²⁷ that the unpleasant sensations experienced by the patient during the process of dilation immediately ceased with the passing of the diathermy current.

²⁵ Arch. Phys. Ther., X-Ray, Rad.

²⁶ Am. Jour. Phys. Ther., Dec., '28.

²⁷ Wiener Klinische Wochenschrift, Oct., '27.

The first treatment was given for ten minutes and the amount of current was 500 to 700 milliamperes, turned on gradually. The result was excellent and after three treatments the patient was entirely free from symptoms. All kinds and amounts of food, even solid food, could be taken. At increasing intervals six additional treatments were given. The author recommends this treatment, as it is painless and not dangerous, before resorting to surgical interference.

CATARACTS, SENILE

E. W. Cox, Everett, Wash., states that his treatment of senile cataracts consists of a large block-tin electrode placed on the back of the neck and extended down between the shoulders; a mesh electrode folded and fitted down over the eyes covering the eyes, eyebrows and most of the nose, the mesh applied damp and with wet towels covering it. The current is applied, starting at about 500 milliamperes and gradually increasing to the comfortable tolerance of the patient, which is found to average about 1000 milliamperes. Tolerance of the patient is always the guide. The length of treatments was from 30 to 50 minutes.

Treatments are given daily for the first month, then every other day and later once a week. Surging sinusoidal treatments are used to agreeable tolerance of the patient, after two weeks.

CATARRH, NASAL

Diathermy is a valuable aid in the treatment of this condition. For technic see *Diathermy to Nose*, pp. 90, 91. Treat five to fifteen minutes using a non-vacuum electrode with sufficient current to produce a sense of warmth to the inflamed mucous membrane.



Application of electrodes

CELLULITIS

Diathermy is of value in this condition because it relieves pain, combats the infective agent, stimulates phagocytic activity, and hastens resolution. Preliminary to the treatment of cellulitis with diathermy one must make sure that suppuration has not taken place. If pus is present surgical drainage must be performed following which diathermy is of distinct value. If the

case is seen during the early inflammatory stage, most cases will respond readily to diathermy. This may be applied by means of the diathermy clamp or block tin electrodes, if the surfaces are such that they may be applied.

The dose should be fairly low milliamperage continued for a long period.

About 750 M. A. to each 15 sq. in. of electrode surface for 45 min. to an hour, once or twice daily till inflammation subsides. Careful watch should be kept for signs of suppuration and should this occur free drainage should be instituted before continuing the diathermy treatments.

CEREBRAL HYPEREMIA

Place large block-tin electrode over abdomen and have the patient lie on the autocondensation pad. Treat for twenty or thirty minutes at 600 milliamperes. This stimulates the vasodilator fibres and produces a congestion in the splanchnic area, automatically depleting the cerebrum. This treatment is very effective.

CERVICITIS. UTERI

Also, see section on Diathermy in Gynecology, pp. 70 to 74.

The method commonly employed before the advent of the new device which we will describe in the following, was to place a large indifferent electrode on the abdomen and a small active electrode or rod, in the cervical canal. However, by this process the diathermy current travelled through a variable amount of tissue, including skin, fascia, muscle and intestinal wall, and the resistance of these tissues decreased the efficiency of the action of the current at the cervix. It was indeed difficult by this method to determine the amount of current required in the extent of destruction of tissues.

Accordingly an electrode has been designed (the Modified Cherry Cervical Electrode) in which both electrodes are made active, and so small that they can lie side by side in the cervical canal in contact with the mucous membrane from the internal to the external os. The current in passing from one of the small electrodes to the other traverses about $\frac{1}{8}$ of an inch of tissue. The electrode consists of a handle with a small tip of insulating material, along each side of which tip and separated by $\frac{1}{8}$ of an inch, are two parallel metal plates which come in contact with the endocervix along the side of the canal.

This bipolar instrument makes possible the predetermination of the extent of destruction which is to be accomplished. It is possible to ascertain in advance of the treatment that a certain milliamperere reading (via short circuit method) on a certain machine will in a certain number of seconds produce the desired coagulation within the endocervical canal. This makes the application an exact science.

Another point in favor of this procedure is its extreme simplicity. Any clinician can safely do expert work in his office without fear of complication. This technique requires far less knowledge and experience than is required when utilizing cautery,



Cherry Cervical Electrode

curette or electro-surgical tissue-cutting operations. It is a painless procedure, no anaesthesia being required in the average case, and at the same time it is ambulant. The patient does not sacrifice occupational time, nor is she subjected to subsequent menstrual disturbance or pain.

Since this method enables the removal of the endocervical glands with the least destruction of uninvolved muscular tissue—less than any method now available—there is naturally less chance of stenosis and functional impairment of the cervix.

The absence of hemorrhage by this method is noteworthy.

A number of gynecologists have challenged the statement that an erosion covering that area of the cervix outside of the external os would clear up as a result of the coagulation of the endocervical glands without further treatment. Several hundreds of cases have been treated and the fact definitely proven that in the majority of cases at least, the erosion does resultantly clear up. In a series of over one hundred carefully supervised cases at a Clinic at the Harlem Hospital, New York, it was shown quite clearly that this erosion did automatically clear up when the endocervical glands were coagulated between the external and internal os—this level apparently being the contributing factor to erosion externally. In this connection proliferation of epithelium takes place within the length of the cervical canal, expands outward gradually and replaces the eroded area to the end that inspection six weeks later reveals what appears to be a condition comparable to the normal cervix.

It appears then that fundamentally it is entirely unnecessary to treat the eroded area of the cervix. There are occasions, however, when a certain additional area should be coagulated, and this can be done with the Cherry Electrode in the following manner. After the cervical canal has been coagulated, the speculum is partly collapsed which in turn allows the partial eversion of the superior and inferior lips of the cervix over the electrode, which electrode has been left in the cervical canal in its original position. Repeating then the coagulating procedure in this position coagulates a large section of the eroded area around the external os.

Existent cysts are punctured with the monopolar current utilizing a sharp needle, or may be coagulated with the bipolar current.

Forty cases of extensively eroded cervixes were selected at Harlem Hospital Clinic. In half that number coagulation of the cervical canal between the interior and exterior os was done with the Cherry Electrode disregarding the erosion entirely. The same procedure was followed in the second group, and in ten cases bipolar superficial diathermy was utilized for the purpose of coagulating the entire cervical erosion. In the remaining ten cases the eroded area was subjected to the point of superficial dehydration with the monopolar current. For all practical purposes the ultimate healing time and the replacement of epithelium over the eroded area was the same in all cases whether the erosion was treated or not.

Another point in connection with this procedure is that the type of infection and the degree of virulency of that infection of the cervical canal seems to be entirely irrelevant as far as this treatment is concerned; in other words, there seems to be no contra-indication, and about the only other suggestion connected with the technique other than the collapsing of the speculum and the proper rotation time of the electrode, plus of course the proper amount of milliamperage, is that the operator should endeavor to recognize the "feel" of the internal os and be able to retract the active point of his electrode 1 mm. or two back from this muscle before actually turning on the current. Even this, however, is not important since the only resultant damage of getting in close proximation or even through the internal os is a slight discomfiture as would be manifested by referred pain on the part of the patient.



*Cross Section of Uterus Showing Position for Patient, Cherry
Electrode Introduced into Cervical Canal*

No anaesthesia is employed for this work, though occasionally a patient, probably one of the neurotic type, complains a trifle. This is not important since the entire treatment is of short duration.

It is occasionally necessary to recoagulate the cervical canal after a period of four or five weeks, because the coagulated area has not been carried to sufficient depth at the original treatment. In most cases, however, one application will be found sufficient to clear up the cervical canal as well as existent erosion, eversion and the various types of discharge about which the patient complained.

Dependent upon the extent of the involvement, an area of 2 to 4 mm. of coagulation should appear around the external os after the treatment.

For the best end results it is apparent that relatively slow, even coagulation such as would leave the coagulated area entirely soft, would be most desirable. For example, on the Fischer "G2" Machine a short circuit milliamperage between the medium voltage and indifferent outlets using an ordinary six-foot dia-

thermy cord to create this short, is about 2,200 M.A. This causes a very even coagulation throughout the entire length of the cervical canal to a depth of 3 to 4 mm. in the average cervix in from 6 to 8 seconds. Sometimes, however, longer time is required as for example where the cervical canal is quite large and electrical contact not good.

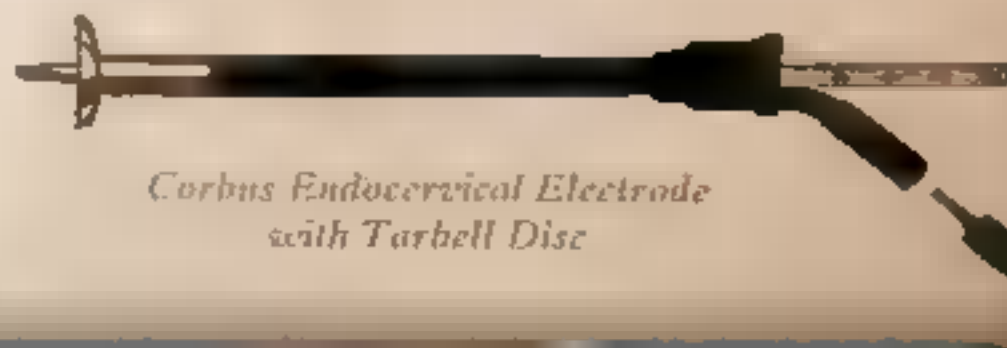
The physician can readily observe the results of the treatment by the depth of coagulation; a cross section at the external os reveals this.

Accordingly a second treatment will occasionally be required of a few additional seconds.

The illustration shows the position of patient, speculum and electrode for coagulation of the cervical canal. The stem of the electrode is held between the thumb and index finger, and revolved back and forth at the rate of about one complete movement each second, until proper coagulation is accomplished. When it is desired to coagulate a cervical erosion of the external os, collapse the speculum a trifle so as to evert the cervical lips and retract the instrument about half way. The instrument is then rotated between the thumb and forefinger the same as in the foregoing, and at the same time describe an arc with the handle (to the limit permitted by the speculum) over the area which is to be further treated. The diathermy current should never be turned on until the instrument is in proper position, and should always be turned off before removing. No after treatment is necessary except that patients are instructed to take a saline douche twice daily. Patients are likewise advised to expect a rather extensive increase in discharge for a week or so following treatment.

CERVIX, STENOSIS OF

Use special Corbus or other type of small endocervical electrode. Elevate temperature until sufficient tissue destruction is produced to ensure a normal sized cervical opening. After the process has healed, sounds should be used occasionally in order to prevent cicatricial formation and a recurrence of the stenosis.



*Corbus Endocervical Electrode
with Tarbell Disc*

CHANCROID

Chancroid is best treated by desiccation. The sore should be carefully cleansed, a local anesthetic applied, and time allowed for the parts to become thoroughly anesthetized. Apply direct spark until all of the Chancroid has been thoroughly charred. The after-treatment consists in absolute cleanliness of the part, though patients are grateful where soothing ointments are applied.

CHOLECYSTITIS

Diathermy, while of value in the treatment of an inflammation of the gall bladder as in other inflammatory conditions, compels the physician to bear in mind the danger of rapidly breaking-down a purulent gall bladder and producing a general peritonitis in a portion of the abdomen where as a rule it is rapidly fatal. Electrodes should be 5x7" in size or slightly larger. Place one over the gall bladder and the other on back just opposite. Diathermy up to 1,000 M.A. should be employed for 20 to 30 minutes. Never pass the point of comfortable toleration. Treatment of gall bladder disease by physiotherapy as well as medication, requires time and patience; results appear, not in a week, but in several months.

CHOLESTEREMIA

The use of diathermy for conditions in which the blood cholesterol is obviously altered by other than purely mechanical means (such as chronic nephritis) is postulated on the basis that, apparently, treatment with diathermy lowers blood cholesterol.

The contra-indications to the use of diathermy are those conditions associated with a marked hypocholesteremia.

Physiologically, the lowering of blood cholesterol by diathermy seems to offer new therapeutic indications.

These conclusions were reached from studies by Dr. Kobak on a number of patients with a variety of surgical and other conditions, selected at random from the Cook County Hospital and from the Rush Medical Central Free Dispensary. In general, blood was obtained from the arm in the usual manner; diathermy was applied over the region of the liver and gall bladder; and a second specimen of blood was again collected following the treatment. A d'Arsonval type of current was used. There was nothing unusual in the manner of application, it being essentially that recommended for the treatment of this region by competent workers. With the apparatus used, the milliam-

peres registered about 1200, the current density was between 60 and 70 milliamperes for each square inch of active electrode surface, and the treatment lasted one-half hour. The blood cholesterol was determined by an established method of known accuracy, for which method it is claimed that the normal range of cholesterol is between 140 and 160 milligrams per 100 cubic centimeters of blood. The results revealed a lowering of the blood cholesterol in each of the 21 cases studied.

CIRCULATORY DISTURBANCES

Dr. T. F. Cotton, at a meeting of the Section of Electrotherapeutics of the Royal Society of Medicine, dealt with the results of diathermy in disturbances of the cardiovascular system. The value of the treatment, he said, depended entirely upon the production of heat within the body; there was general agreement that no other special effect came into play. Lewis had lately advanced the view that the reaction of dilatation of the arterioles, venules, and capillaries to changes of temperature was dual; there was a direct influence of heat evidenced in a lessening of tone of the walls of the small blood vessels, and also an indirect (and predominating) influence of heat in increasing the concentration of vaso-dilator substances in the tissue spaces. This reactive hyperaemia, with increased blood flow, was the mechanism of fine adjustment which governed the nutrition of the tissues. It was probable that the deeper vessels reacted in a manner similar to that of the cutaneous vessels, and, this being the case, diathermy in the treatment of disturbances of the cardiovascular system had a direct relation to the physiological facts.

It followed from this explanation of the mechanism of response of the blood vessels to heat that when constrictor influences predominated and caused alteration in the peripheral circulation, with eventual pathological changes, the release of these vaso-dilator substances, causing the small vessels to dilate, brought about the restoration of the normal circulation and blood supply to the tissues. Diathermy, therefore, seemed to have an appropriate part to play in the treatment of such conditions.

CONJUNCTIVITIS

Vacuum or non-vacuum eye electrodes may be used, but a special metal electrode as used with the diathermy headband serves best. Treat five to ten minutes using low milliamperage. For application of electrodes see page 63.

COCCYGODYNIA

If this is produced by an injury to the bone or inflammation, diathermy will prove useful in its treatment. Patients in whom no pathological condition is apparent and the pain is only a symptom of a neurotic affection, may be benefited from a psychological effect. Apply one electrode over painful area and another—much larger—electrode over the lower abdomen. Treat twenty minutes at 1500 milliamperes.

COLIC, GALLSTONE

See pp. 65 and 66.

CORYZA, ACUTE

Dr. Tsinonkas says²² that he was led to apply diathermy in the treatment of coryza by observing the good effects of steam inhalations on patients suffering from this disease.

Cylindrical electrodes are used. The electrodes are placed on the soft parts of the exterior of each side of the nose. The patient, himself holding each electrode, is placed comfortably in a chair. After ten minutes, the current having reached an intensity variable with the patient, 500 M.A. on an average, the patient is told to raise the electrodes gently along his nose without changing his position. The nostrils are cleared and the patient is asked to breathe. Usually the patient already acknowledges an improvement.

The treatment lasts 20 to 25 minutes. A single treatment is sufficient, if there do not exist any chronic changes of the nasal fossae, polypi or hypertrophy of the turbinated bones, etc. After the treatment the respiratory difficulty disappears and sneezing ceases, mucous secretion is drained and the patient confesses to a remarkable well being. Patients with a stronger attack of acute coryza can bear a more intense current than patients with a lighter attack.

Also, see Diathermy to the Nose, pp. 90, 91.

CYSTITIS, ACUTE

Place electrode over lower abdomen, with larger indifferent electrode underneath sacrum. Raise milliamperage to patient's skin tolerance and treat thirty minutes to one hour daily. Some advantage is gained by having the bladder distended during treatment. The patient voids immediately after the treatment, thereby washing out the inflamed bladder.

See discussion of Chapman's Electrode under "Gynecology."

²²Arch. D'Elec. Med., No. 523, '27.

CYSTITIS, CHRONIC

The treatment of chronic cystitis does not differ from that of the acute, except that the treatments need not be so prolonged and may be given only three times weekly. It is often necessary to wash out the bladder after treatment with a warm boric acid solution as many of these patients have retention of urine.

See discussion of Chapman's Electrode under "Gynecology."

DUODENAL ULCER

Diathermy is used in duodenal ulcer to relieve the pain, and to promote healing. Treat thirty minutes daily elevating the milli-amperage to the patient's skin tolerance. If the patient experiences vertigo or malaise during or after treatment, (over stimulation of the solar plexus with splanchnic congestion), lower the amperage. Apply 5x6 in. electrodes over the source of the pain and underneath the shoulders or spine. Quartz light treatment is a valuable adjunct.

DYSMENORRHEA

Cumberbatch and Robinson in England report that they have treated with diathermy congestive dysmenorrhea, climacteric flooding, and arthritis secondary to a chronic endocervicitis. They found the swelling, pain and disability of the arthritic joints to subside rapidly following several applications of diathermy to the infected cervix.

Thomas B. Sellers, M.D., New Orleans says,²¹ "It is no longer a debatable question as to the value of diathermy in chronic pelvic infections. It not only assists in relieving symptoms but frequently obviates surgical interference."

DYSPEPSIA

The observations of Klyachkin and Mogilevskiy³⁰ were made on forty-two patients with various dyspeptic disturbances. In cases of organic achylia, the treatment had no influence on the gastric secretion; but it induced improvement of the general condition and caused the disappearance of subjective signs which had previously resisted various remedies and diets. Therefore, diathermy was recommended for patients with dyspeptic manifestations, regardless of the condition of the gastric acidity.

EARACHE

For intractable otalgia, diathermy should be used over the mastoid region for 30 minutes, followed by negative galvanism

²¹ Paper, 8th Ann. Cong. Phys. Ther., Nov., '39.

³⁰ Kazansky Med. Sur., 26:963.

for 5 minutes. Repeat in 12 to 24 hours as indicated. Make sure that there is no pus under pressure behind the tympanum.

EAR. DIATHERMY TO

A. R. Hollender, M.D., Chicago, Illinois,³² summarizes and concludes an article entitled "Rational Uses of Physical Energies in Oto-Rhino-Laryngology," by saying, "Middle-ear deafness is an indication for medical diathermy, especially after the usual methods have failed to bring about improvement."

Diathermy introduced by way of the ear canals does not reach the middle and inner ears with adequate intensity. The active electrode is placed in contact with the mastoid area of the ear being treated,



Application of Indifferent Electrode

while the indifferent electrode is placed on the opposite side, anterior to the ear. One ear is treated at a time. The point of greatest heat with the above technic is at the petrous portion of the temporal bone. Three to four treatments weekly are given with a milliamperage of 250 to 400. The time of each treatment is 20 minutes, after which negative galvanism is applied for 5 minutes. The number of treatments is determined only by the requirements of each individual case. This method is now being extensively employed for all types of otitis media.



Application of Active Electrode to ear by means of headband



Showing Headband and Special Electrodes for use in Diathermy Treatment of Eye and Ear

Dr. Dan McKenzie, of Glasgow, Scotland, says³³ that in the presence of pus or in cases with very definite otosclerosis, diathermy is contra indicated. Diathermy promises the best results in "dry deafness."

³² *Ann. Jour. Surg.*, Feb., '30.

³³ *Eye, Ear, Nose & Throat, Mo.*, June, 28.

ELECTRODE,
NON-
VACUUM

At Left—Use of non-vacuum electrode, with monopolar current, in treatment of facial and glandular conditions. $\frac{1}{8}$ to $\frac{1}{4}$ in. spark, treatment for 10 to 15 minutes.



At Right—To avoid unpleasant sparking when making contact, connect tube to multipolar outlet of machine, regulate spark, then place your fingers on electrode until it is in contact with patient (See illustration in oval.) Fingers are then removed and electrode is moved over area to be treated.





ELBOW, DIATHERMY TO

Application of electrodes by means of Diathermy Clamp. A satisfactory and effective method. Milliamperes, 800 to 1200, patient's tolerance.

Showing Electrodes held in place by Diathermy Clamp

ENDOCERVICITIS

See Cervicitis Uteri, pages 51 to 55.

ENDOMETRITIS

See section on Diathermy in Gynecology, pp. 70 to 74.

EPIDIDYMITIS

Apply Corbus epididymis electrode and treat daily or twice daily—twenty minute periods—until condition is relieved. Never exceed patient's comfortable tolerance.

ENDARTERITIS OBLITERANS

Charles E. Stewart, M.D., says²¹ that the agonizing pain which is so frequently present in endarteritis obliterans is often favorably modified and sometimes entirely disappears for a time at least by the application of diathermy to the legs.

²¹Am. Jour. Phys. Ther. Jan. 1927.



Application of Active Electrode to eye by means of headband

EYE. DIATHERMY TO

Diathermy to the eye is best applied directly by means of a metal electrode. The most convenient method is to apply the headband and special eyepiece. Various eye affections are now being treated in this way.



Application of Indifferent Electrode

Dr. Merimanoff says²⁵ that diathermy is a valuable adjuvant in the treatment of blepharitis, conjunctivitis (especially gonorrheal), corneal ulceration, inflammatory conditions of the sclera, retrobulbar and orbital tumors, and after enucleation, before adjusting the artificial eye.

FRACTURES (After-Treatment)

Diathermy applied in these conditions will stimulate nutrition and promote rapid healing, convalescent time may be shortened from one-third to one-half, and many deformities obviated.

If it can be arranged, a diathermy treatment should be applied to the fracture before the immobilization dressing is put on. This will contribute largely toward preventing swelling and eliminating pain; it will promote callus formation.

Never enclose electrode plates in a cast with a view to applying diathermy to the limb within the cast. Instead, remove the cast or immobilizing dressing daily and apply the diathermy treatment. If this is not possible, windows may be left, through which the treatment may be applied. Otherwise, allow sufficient time for a callus to form that is strong enough to hold the ends of the bone in position, which is ten days to two weeks; and then begin applying diathermy, continuing the immobilization.

Diathermy is also useful in building up the nutrition of muscles that have remained in a cast for many weeks; to this should be added massage, and stimulation by sharp sparks from the glass-vacuum electrode.

Proper use of the electrical modalities in fracture of the elbow will avoid the permanent disabilities which sometimes follow injuries of this nature.

Various methods of treatment shown on the following page.

²⁵Rev. Gen. D'Ophthalmol., No. 3, '27.



FRACTURED ELBOW

Applying Electrodes

*At Left—Elec-
trodes applied
laterally.*



*At Right—
Method of band-
aging electrodes
in place with
elastic bandage.*

FISSURE IN ANO

Dilate the sphincter under an anesthetic. Treat by direct fulguration or use cautery. Dress with oily antiseptic dressing. Healing is usually complete in one week.

FISTULA IN ANO

If the fistulous tract is long and tortuous, surgery is the only recourse. If it is possible to insert an aluminum probe throughout the length of the tract, this can be used as the active electrode, and the walls of the tract electrocoagulated. If the coagulation takes in all of the diseased tissue, healing by granulation will take place. Keep the tract drained by irrigation. If the coagulation was not thorough enough the first time, the procedure can be repeated in ten days or two weeks.

GALLSTONE COLIC

Miles J. Breuer, M.D., Lincoln, Nebr., says that diathermy, applied from front to back through the gall bladder region, continued for a sufficiently long period of time, increases local nutrition, relieves the inflammation, relaxes spasm, promotes elimination.

We assume that by gallstone colic is meant the pain produced by the passage of biliary calculi through the cystic, hepatic or common bile ducts.

When the stone starts down the duct, the irritation produced immediately sets up a spasm which persists until the smooth muscle



Diathermy Treatment of Gall Stone Colic



Application of Electrodes in Gall Stone Colic

fibres of the duct are tired to the point of relaxation. The acute pain then somewhat subsides, only to recur on subsequent irritation. This accounts for the paroxysmal character of the pain of gallstone colic.

Diathermy is of distinct value and should be employed during an attack of gallstone colic, as it favors a relaxation of the duct and permits the stone to pass into the duodenum.

A tin plate electrode 6 x 4 inches is applied under the seat of pain in the dorsal region, another 4 inches square is placed anteriorly so as to include the painful area. It is held in place by sandbag. Use 1000 to 1500 M.A.

GANGRENE

In the predisposing stages, before tissue death has taken place, especially in the cases of endarteritis obliterans, a great deal can be accomplished by diathermy toward preventing the supervention of gangrene.

GONORRHEA

Heat is a specific for all gonococcal infections; the only problem that confronts the physician is the effective application of diathermy to the infected area. This problem has been solved in the female; refer to the section on Diathermy in Gynecology, pages 70 to 74. In the male, however, this problem assumes greater proportions. No procedure that will apply in all cases has been perfected as yet, but the following methods have met with more or less success in the hands of their originators.

Wolbarst says,* "Diathermy is the most useful of recently introduced methods of treatment; it is practically a specific. The pain is almost immediately controlled and the incapacitation is reduced from weeks to days."

Rowell uses an electrode consisting of two parts—a bakelite frame with two adjustable pieces of metal, curved to fit the outside of the penis, and a straight, nickel-plated, perforated electrode to be inserted into the urethra. The latter is attached to one pole of the diathermy current and the external electrodes are connected to the other pole by means of a multiple connector and a double cord. A special thermometer in the urethral electrode makes it possible to keep a constant check on the temperature.

The thermal death point of the gonococcus is given as 104° F. for a period of 6 to 8 hours, or 108° F. for 30 to 40 minutes. It is therefore reasonably safe to assume that a temperature of 109° F. to 110° F. will destroy the organism in living tissue in 30 or 40 minutes, and this degree of heat can be very easily obtained without any discomfort to the patient. In fact it is possible to apply a uniform heat of 112° F. to 114° F. to the male urethra from the cut-off muscle to the meatus. Rowell has had better results, however, with a temperature of 109° for 30 minutes than with the higher temperatures. It is also possible to apply a solution of mercurochrome, acriflavine or any other drug desired to the urethra during the diathermy treatment.

One objection to this treatment is that it necessitates instrumentation of the urethra, and therefore is contra-indicated in acute cases. However, the urethral electrode can be made as small as No. 16 French, and it is Rowell's opinion that the good obtained by the treatment will more than offset any harm that may be done by the insertion of so small an instrument.

Eugene B. Perry, M.D., Chicago, says,† "The diathermy treatment consisted of snugly enclosing the penis with the whole pendulous and scrotal urethra between the ventral and dorsal

* *Am. Jour. Surg.*, IV, 1.
† *Arch. Phys. Ther.*, X, 122, *Rad.*, Feb., '28.

electrodes after lubricating these plates with the prepared soap. The indifferent pole attached to the dorsal post and the active pole to the ventral post. Then the patient is cautioned to keep his hands behind his head and the current turned on and gradually stepped up at five-minute intervals to the point of toleration. On several occasions I have reached 750 milliamperes without serious complaint. By occasionally inserting a bare thermometer a short distance in the urethra an accurate idea of the temperature developed may be thus obtained. This latter procedure is only infrequently resorted to and is only occasionally necessary. My temperature range, I discovered to be between 110° and 114° Fahrenheit, without discomfort to the patients.

"The length of each treatment depended upon the temperature I was able to develop and varied between 30 to 60 minutes. The patient is then allowed to urinate and an injection of 5 per cent argyrol given. One must remain in constant attendance during the treatment as the penis changes in size frequently, thus diminishing the area in contact with the electrodes, requiring readjustment after momentarily turning off the current.

"These treatments are given daily or every other day, depending on their individual length, the temperatures developed and the patient's tolerance. Should the patient have a very profuse discharge it seems advisable to diminish the length of the treatments and give them more frequently in order to prevent the damming back of purulent material into the posterior urethra."

William Bierman, M.D., New York City, says²⁸ that there are several ways of applying the high frequency current to the penile urethra. The penis may be plastered down against the anterior abdominal wall as the patient lies on his back. A copious quantity of soap suds is placed between the penis and the abdomen, so that for electrical purposes that organ becomes an integral part of the anterior abdominal wall. A narrow strip of composition metal is placed over the penis and connected to one pole of the diathermy machine. This metal strip should extend from the meatus to and slightly beyond the penoscrotal junction. If it is prolonged too far down on the perineum, most of the current will pass from this portion to the other metal electrode used to complete the circuit and which is placed under the lower back and buttocks. This latter electrode may be of about eight by ten inches. The penile electrode should not be bent around the sides of the penis. This would cause the current to pass mainly from the edges of the electrode, particularly if it touched the abdom-

inal wall. The major heating effect would then be lost where it was most desired—in the urethra. This method is of great value in the treatment of preputial edema. All metal electrodes should be well moistened with soap suds when applied.

Roucaÿrol uses a special urethral electrode which is inserted inside the penis with an indifferent electrode over the abdomen. This special electrode carries a thermometer and Roucaÿrol treats for twenty minutes daily with the thermometer registering 45° Centigrade. He claims excellent results.

Corbus & O'Connor also use the special endo-urethral electrode and recommend temperatures of 108° F. and even higher for thirty minutes. Indifferent electrode over abdomen or sacrum.

For the active electrode Chapman uses silver mesh, cut in such a way that it can be wrapped around the anterior third of the penis. Antiseptic soap is applied freely to insure a good contact during the treatment. To prevent short-circuiting the current through some other part of the body (the thigh if the patient is treated in a sitting position, or the abdomen if he is lying down) the penis is placed in a small saucer, either on the legs or abdomen. A large piece of block tin on the patient's back serves as the indifferent electrode. Treatments are given for 60 minutes daily at the patient's point of tolerance.

Another method that has met with some success is to suspend the penis in a small jar containing salt solution which acts as the active electrode. In this treatment care must be exercised to prevent burns as the glans penis is almost devoid of heat fibres and unless a considerable portion of the penis is immersed in the solution, scalding may result.

The Cumberbatch method of applying the diathermy follows: A ribbon of lint, 1 inch wide, soaked in saline, is wrapped around the free end of the penis, and around the lint is placed a metal band. This is connected to the diathermy machine. An indifferent electrode is placed above the pubes. The current is gradually increased, and the penis is kept as hot as can be borne without discomfort, for 10 minutes.

In treating gonococcal urethritis, the indifferent electrode might be replaced by a second active electrode placed on the perineum. The prostate and the prostatic part of the urethra might be treated by a slightly concave metal electrode, shaped like a shallow spoon, mounted on an insulated handle, and placed in the rectum and pressed against the prostate.

GYNECOLOGY. DIATHERMY IN

R. Alamanni says⁷⁹ that he has investigated the physical-biological healing properties of diathermy in a large number of cases. In inflammation of the adnexa he found cures in 77.98 per cent of the cases, improvement in 20.8 per cent, and made worse in 1.8 per cent. He observed the same results in pain in the lumbo-sacral region. Good results were noted in retroversio uteri, where the therapy gradually led to a mobilization of the organ. Whereas there occurred no noteworthy improvement in amenorrhea, the success in dysmenorrhea was remarkably good.

Diathermy, when used in the treatment of inflammatory diseases of the female pelvis, has the following general effects:

1. It alleviates pain. 2. It has a localized action. 3. It increases the blood supply to the part. 4. It leaves no bad after-effects. 5. Bacteria are either killed or attenuated in virulence according to their ability to resist high temperatures. The gonococcus is attenuated in virulence and prevented from reproduction by a temperature of approximately 104° F.

On account of its analgesic action, diathermy is indicated in painful menstruation. On account of its vaso-motor effects, it is indicated in amenorrhoea. Its greatest value, however, lies in the treatment of inflammations in which it has a specific action upon the infective agent as well as in producing the general beneficial effects already mentioned. The technic in all of these conditions is approximately the same. Any variation from the routine treatment is given underneath specific title of disease.

From what has already been said, it is apparent that, in the treatment of gynecological conditions by diathermy, we are more concerned with the location of the disease than with its specific cause. We are aware, however, that pathogenic bacteria behave differently when exposed to heat, and will mention the resisting power in vitro of a number of the micro-organisms that are found most frequently in pelvic infections.

Streptococci—110-125° F., in from 10 to 20 minutes.

Staphylococci—140° F. in approximately 30 minutes.

Tubercle bacilli—140° F. in approximately 20 minutes.

Gonococci—140° F. in approximately 30 minutes.

You will note that the thermic resistance of the gonococcus in vitro is as high as that of any of the other pathogenic micro-organisms. This is significant as it has been found that in vivo

⁷⁹*J. Actinother.*, 6, 2, '27.

the gonococcus is prevented from reproduction by temperatures in excess of 104° F., and Corbus & O'Connor claim that 108° F. destroys the micro-organism in 30 minutes. Ehrich states that the time is much less, but the importance of these factors is merely to determine the duration of the treatment, and it would appear that where it is possible to elevate the temperature of the tissues to 108° F., 30 minutes time is sufficient to destroy all common types of pathogenic bacteria.

E. P. Cumberbatch, M.D., London, England, treats urethra first, whether infected or not, as a guide of strength of current to be used in the insensitive cervix. The urethral electrode is a thin-walled metal tube about $3/16$ inch in diameter, the end of which is rounded and closed. A thermometer is inserted into applicator so that accurate readings may be observed. The circuit is completed by a belt electrode $3\frac{1}{2}$ inches wide and long enough to pass around the pelvis, with free ends overlapping. The contact side of this belt electrode is coated with soap lather before applying. Secure ends of belt with adhesive tape.

Treatment is started with a very weak current, and the milliamperage is increased gradually. The patient will become aware of the heat and finally will advise of discomfort; then reduce to a point where pain is no longer felt, and thermometer reading will usually indicate between 113° and 115° F. Treatment should last 10 minutes.

Remove applicator and pass speculum into vagina. The cervical electrode is a flexible metal rod made of block tin about $3/16$ inch in diameter. At a point $3/4$ inch from the smooth rounded end, this electrode is bent at an obtuse angle. A flexible rubber tubing is passed over the rod.

Insert the bent end into the canal of the cervix, and then slip down the rubber covering until it comes in contact with the cervix. Start treatment with little current, and gradually increase the milliamperage until approximately one-half the current is being employed as when treating the urethra. Continue treatment for at least 10 minutes. It is not necessary to use the thermometer for this treatment. If electrode employed is less than $3/16$ inch diameter, reduce milliamperage in proportion. Treat bi-weekly.

Joseph E. G. Waddington, M.D., of Detroit, says:⁴⁰ "The Cumberbatch-Robinson treatment of gonorrheal arthritis, with diathermy directed intensively to the involved genitourinary organs, should be instituted whenever such infection may be even remotely considered etiological."

Treatment with the Chapman Vaginal Electrode

This instrument is furnished in two sizes, and comes either with or without the thermometer attachment. For accurate work, however, the thermometer is absolutely essential.



Fig. 1. Chapman Vaginal Electrode with Thermometer

Application of Electrodes

In the treatment of buboes, perineal abscesses, ulcers, vulvitis, anterior vaginitis, anterior urethritis, etc., a mesh sponge applied directly to the infected area with a larger indifferent electrode over the abdomen or the sacrum is indicated. In the treatment of disease of the internal female organs, however, the special Chapman Vaginal Electrode should be used.



Fig. 2.—Insertion of Chapman Electrode

This instrument is introduced edge-ways into the vagina and, after insertion, is rotated into position (Fig. 2). When properly applied it automatically engages the cervix within the cervical bowl and elevates and supports the uterus, while the vulva closes over the insulated vulval groove and helps to hold it in position. These factors are of practical importance as all other types of vaginal electrodes will work out of the vagina during treatment. The

knees are flexed and widely separated while the electrode is being inserted, but the legs are extended during the treatment, the attachment cord from the vaginal electrode passing down between them to one of the binding posts of the d'Arsonval connection.

Precautions in Applying Electrodes

The vaginal electrode should be lubricated with glycerine, K-Y jelly, or liquid soap for introduction into the vagina. The surface underneath external electrodes should be shaved and the skin and under surface of the electrode coated with soap lather. The umbilical depression underneath the indifferent electrode should be filled with liquid soap and all electrodes applied snugly.

Failure to observe these factors will cause a variation of from five to ten degrees in the heating effects obtained within the tissues and make for the success or failure of a valuable therapeutic agent.

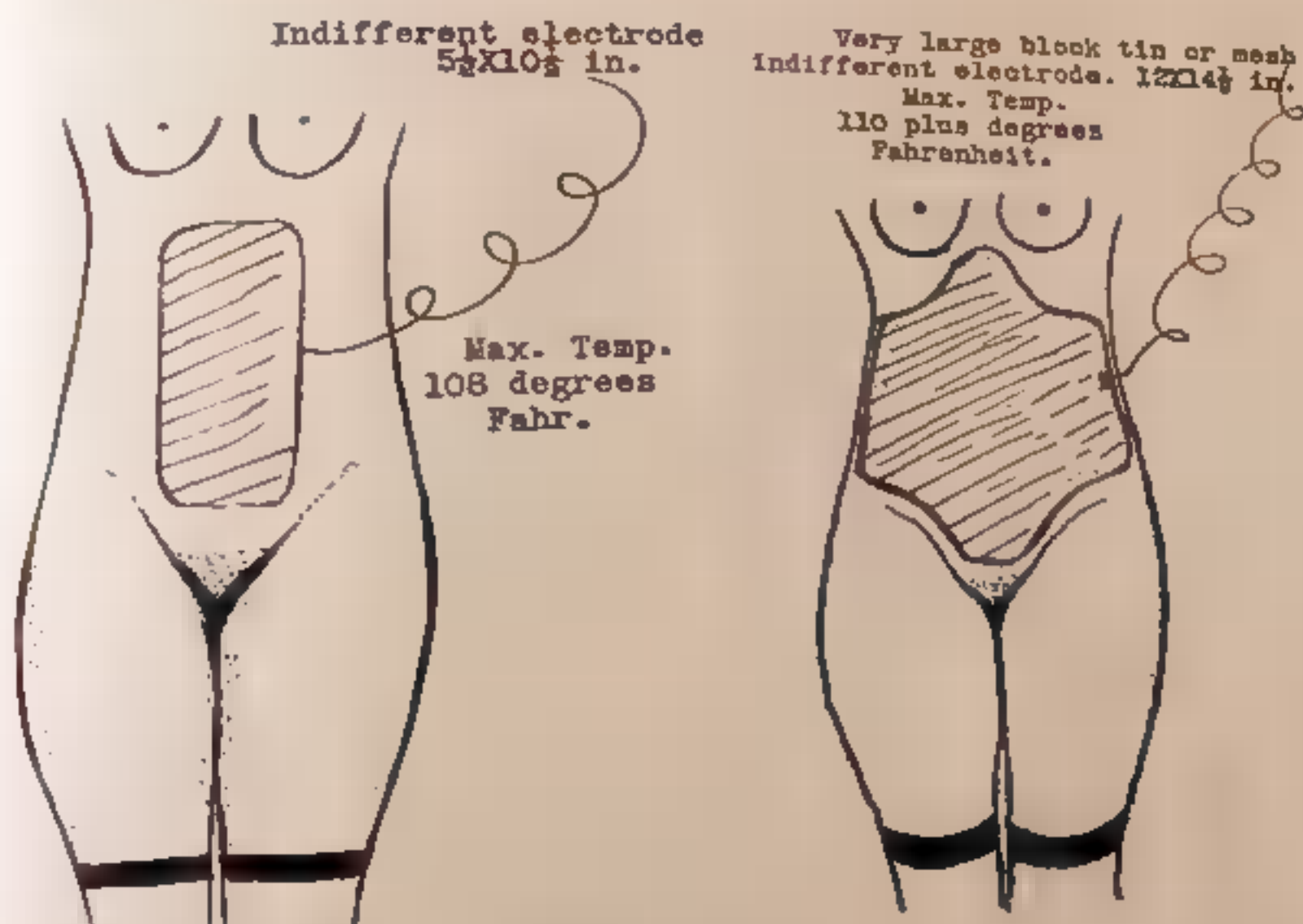


Fig. 3. Ordinary Indifferent Electrode

Fig. 4. Extra large Indifferent Electrode

The Indifferent Electrodes

The application of the indifferent electrode is almost as important as that of the active or treating electrode. Figure 3 shows the type of electrode that may be used and its proper location. This electrode is of block-tin and is 5½ x 10½ inches in size. It will allow an elevation of temperature inside the vagina of 108° F., which is sufficient to secure the required therapeutic effects. By using an extremely large indifferent electrode as in Figure 4, intra-vaginal temperatures of from 110° to 113° F. may be obtained. It has been found, however, that tissue necrosis is threatened by temperatures around 112-115° F., and we do not recommend temperatures above 110° F. for general treatments.

Contra-Indications to Treatment

Where there is an enclosed abscess within the pelvis, this treatment should not be used. Chief of these is an old pyosalpinx or an abscess in the cul-de-sac of Douglas. Either of these conditions if treated by diathermy may break down and rupture inside the peritoneal cavity. These conditions should be detected by a careful pelvic examination. The palpation of a mass to either side of the uterus, or even a rigidity with slight deviation of the uterus to one side or the other, combined with some tenderness on pressure, should make one suspicious of an old pyosalpinx, and if diathermy is used at all we must proceed very carefully, as one normal treatment will often suffice to set it off. Even if there is no pus present at the beginning of treatment, the increased heat to the infected area will cause a rapid breaking down of the devitalized tissue with pus formation, and if the direction of least resistance is towards the peritoneal cavity it will rupture into it with a consequent peritonitis with all of its attendant dangers. In the event of this, the only recourse is operation and drainage. Pregnancy and ectopic gestation are also contra-indications for the use of diathermy.

The illustration below shows a typical diathermy treatment of the type mentioned on page 72. Indifferent electrode is applied to the abdomen, active electrode inserted in the vagina,



with the electrical cord extending downward between the patient's knees as mentioned in the description of the technic. Cord thus aids in holding bowl of electrode firmly against cervix.

Treatment of New Growths

Surgical diathermy, or endothermy, is of extreme value in the removal of neoplasms of the female organs, many of which show a tendency to malignant degeneration. The technic is the same as for the treatment of neoplasms elsewhere and is described under the head of Surgical Diathermy.

See, also, Cervicitis Uteri, pages 51 to 55, and Uterine Cervical Lesions, page 125.

HEADACHE

Massage gently with vacuum electrode and mild current until relief is obtained. Migraine and severe headaches will require the addition of anodynes. Direct diathermy laterally through the head may be tried. Negative galvanism over the forehead. Patient may be placed on the autocondensation pad and operator may then move his fingers gently over the forehead. This type of massage is often more effective than when using the vacuum electrodes.

HEART. DIATHERMY TO THE

Gustav Kolischer, M.D., of Chicago, says, "If heat produced by a high frequency current is applied, the femoral arteries become dilated and the patient will get over the attack. This dilatation will persist for quite a while after the treatment but after a while the treatment must be repeated. While it is not a cure—we cannot change the arteries—we relieve the patient for a long time of all these dangerous symptoms. The arteries of the heart are dilated so it is important not to overdo this treatment. . . . One gets all the good results with no excessive amount of the current. . . . These treatments should not be given oftener than twice a week."

HEMORRHOIDS

George W. Bamberger, M.D., Chicago, Ill., says:¹¹ "Undeniably diathermy is the logical method in hemorrhoidectomy because of its simplicity, comparative painlessness and safety, and in the years I have employed it I have not found a single contra-indication to its use."

William F. Deutsche, M.D., New York City,¹² summarizes the advantages of this treatment for hemorrhoids as follows: First, the lasting effect of the local anesthetic gives the greatest assurance of no possible suffering. Second, the absence of any wound produced by sloughing or otherwise, during the post-operative period, makes the case truly an ambulant one. Third, permanent results which are proven by past experience.

W. B. Chapman, M.D., describes his technic as follows:

During the past several years I have performed quite a number of hemorrhoidal operations by surgical diathermy or electro-coagulation, and the success that has been attained convinces me that in the majority of cases this is the operation of choice.

(Continued on page 77)

¹¹ *Am. Jour. Phys. Ther.*, June, '39.

¹² *Am. Jour. Phys. Ther.*

HEMORRHOIDS—Continued



*Exposing
the pile
by means
of thumb
forceps*



*Injecting
the
anesthetic*



*Coagulating
the pile
by means
of the
needle
electrode*

Cleanse the field and paint over with tincture of iodine. If the hemorrhoid is inside the rectum, it may be exposed in a woman by inserting a finger inside the vagina and exerting pressure on the rectum. If a man, the cup and suction apparatus of the high frequency machine is quite effective. A good rectal dilating speculum will also secure good exposure. When the pile is exposed, grasp it with the thumb forceps (Fig. 1, p. 76) and, using a 2 per cent novocain-adrenalin solution, inject a few drops underneath the tumor (Fig. 2, p. 76). The thumb forceps should be rubber-tipped to prevent pinching. I usually cut short lengths from an old rubber catheter and slip over the ends of an ordinary tissue forceps.

For the operating instrument a sharpened Dillinger needle is very good. Any kind of a needle will do, but I employ the short pointed electrode that comes with the diathermy operating set. This becomes the active electrode of the d'Arsonval circuit while for the indifferent electrode I employ a large piece of block-tin which is warmed and held in place by sandbags. No soap lather is required for contact and it matters little where the inactive electrode is applied. It is also possible to use the auto-condensation pad or handle as the indifferent electrode, but requires much more current and results are not so uniformly satisfactory.

Using a high frequency machine at the lowest tension, set the controls so that the meter will read about two thousand milliamperes when the two electrodes are brought into contact with each other. With the current adjusted, the tumor anesthetized, and the indifferent electrode in place, insert the point of the operating needle into the pile and, using the foot-switch, apply the current until the pile turns a steel-grayish color (Fig. 3, p. 76). This only requires a few seconds. The injection solution inside the pile becomes boiling hot and by scalding destroys the endothelial lining of the dilated blood-vessel causing a coagulation and consequent disappearance of the tumor by absorption.

Hemorrhoidal tabs or "sentinel piles" are largely fibrous tissue and should be coagulated until white. They separate after about ten days and the base heals over with a soft, pliable scar. After coagulation, the hemorrhoids will protrude from the rectum and should be bathed twice daily or oftener with hot boric or cresol solution. This limits the swelling, prevents infection, and relieves pain and soreness.

If there is much after-pain prescribe a suppository of cocoa-butter containing one grain of opium and from $\frac{1}{5}$ to 2 grains of

belladonna. These suppositories are on the market and can be secured from any druggist on prescription. Instruct the patient to insert one suppository into the rectum on retiring, and they may be used as often as is required to ease pain. An ointment containing morphine sulphate gr. 5, tannic acid gr. 10, in one ounce of zinc oxide is also useful.

William J. Wick, M.D., of Chicago, employs a similar technic. "We inject about 15 mm. of a 1 per cent solution of novocain underneath the hemorrhoid. After waiting a short time, introduce the active electrode. A very fine needle is required for this. I use the ordinary No. 7 or 8 cambric needle, and when through discard it. It is smoother and easier to insert than the ordinary coarse one, and does not spread over too great an area. We must not forget that a hemorrhoidal operation is a very delicate one. It is only a very small area we wish to remove. We must not go too deep, only through the mucosa into the submucosa; otherwise, there is danger of causing incontinence or infection, much sloughing and pain. After complete recovery there should be very little scar tissue. Turn on your current until complete coagulation has taken place and the pile is white. This is all that is necessary to do, and in the course of a week or ten days your patient is cured with very little, if any, discomfort or pain."

By the above procedure it is possible to treat successfully any case of piles and the patient may proceed about his daily work. It is best to coagulate only one tumor each time, the patient returning for another treatment, as soon as the soreness from the last is gone. The unfortunate thing about the treatment of hemorrhoids by surgical diathermy is that, especially, inexperienced operators will overtreat and produce so much tissue destruction at one time that the patient is completely incapacitated for several days.

Three or four treatments usually suffice to clean up even severe cases, as the coagulation of one tumor often impairs the blood-supply to several other hemorrhoids, causing them to disappear also.

Another thing, with this operation there is not the danger of hemorrhage, embolism, or infection that attends the old operative procedures, and the end-results are more satisfactory.

Galvanism is also used to advantage in the treatment of hemorrhoids.

HIP JOINT DISEASE

See Tuberculosis of The Hip, page 120.

HYPEREMIA, CEREBRAL

See Cerebral Hyperemia, page 51.

HYPERTENSION

Obviously the first essential in the treatment of hypertension, is to discover and eliminate, one by one, *all* the causes of the condition.

Corrective measures having been taken to eliminate the causes, auto-condensation is the method of choice in the treatment of hypertension.

Auto-condensation promotes an increase of tissue changes and an improved metabolism, with a resultant increase in elimination and removal of the basic cause of the patient's condition.



Patient lying on Auto-Condensation Pad and holding Auto-Condensation Handle in hands

It will be seen that the general rule applying to all therapeutic methods—that treatment must be preceded by careful, thorough and complete diagnosis—finds no exception in the physiotherapeutic treatment of hypertension.

Harry Eaton Stewart, M.D., New Haven, Conn., treats as follows:

Electrodes—An auto-condensation pad and a good sized metallic handle are required.

Application—Patient is placed in a comfortable position on pad, metal handle is held in both hands, a pillow or padding of some kind is placed between the hands and the body to prevent the current jumping.

The average treatment will produce a temporary reduction of B. P. of from 8 to 20 mm. Pressure will usually return to within 5 to 10 mm. of reading at previous treatment. Hyper-

tension may be kept down after reaching the proper level, by periodic treatments, some patients requiring treatment once a week, others not over once a month.

Auto-condensation current is employed of from 300 to 600 M.A. for from 20 to 30 minutes. Be careful not to lower blood pressure too rapidly as this may produce a vertigo or weakness.

Grover says: "The patient should be treated daily until the systolic pressure reaches the same point with each treatment. This will be the point of compensation for that individual. This is the point known as *fixed tension* or point of compensation, and it will be impossible further to reduce the pressure. Auto-condensation cannot impair cardiac sufficiency. When the point of fixed tension is found the frequency of treatments is so regulated that this point may be maintained."

Contra-indications, valvular heart disease, nephritis.

HYPERTRICHOSIS

J. C. Elsom, M.D., says: "Sometimes a mole is filled with large coarse hairs. We first remove the hairs by the following technic: the patient may be seated on the chair pad, which is connected to the central uni-terminal outlet. Enough high frequency current is turned on that will charge the patient, so that when the finger of the operator is lightly touched to the face of the patient, a little snapping spark results (an eighth of an inch or so). Or, the patient may hold a metal bar which is connected to the central terminal of the machine; this produces the same result, and requires less current. A foot switch is connected with the machine. The operator uses a small, sharply pointed needle.

"With the current off, the needle is inserted along the shaft of the hair, penetrating about $1/10$ of an inch, or deep enough to reach the bulbous end of the hair follicle. Make the connection with the foot switch, with the needle in place, and avoid touching the patient's face with the operator's fingers. A second or so will blanch the tissues slightly at the point of the needle, indicating that the desired results have been attained. The current is shut off, the hair removed by a pair of forceps, and if the slight coagulation has been well done, the hair may easily be pulled out. The follicle is thus destroyed, and the hair does not return. A good many hairs may be removed at one sitting, as there does not seem to be so much irritation as is common in galvanism. When all hairs have been removed from a mole, the mole itself is desiccated. If large surfaces are to be treated, several sittings may be necessary."

HYSTERIA

Give massage to spine using surface electrode and $\frac{1}{4}$ inch spark. Treat for fifteen minutes, moving the electrode slowly up and down the spine. If the patient does not respond, try raising the electrode from the surface and give several sharp sparks to the skin. Illustration below shows application of electrode.



*Application of
high-frequency
electrode
in hysteria*

INFECTION

The role of physical therapy in the management of focal infection has an established place now that it has been shown that diathermy will destroy the infection wherever drainage is present. This is true of infected sinuses, gall bladder, and antrum when drained. It is possible to remove foci which would have otherwise required resort to surgical procedures and then with less likelihood of complete recovery than with diathermy.⁴³

INFLUENZA

Curran Pope, M.D., describes his treatment as follows:

The treatment of the acute state calls for *Diathermy* in large doses several times a day. It may be given in two ways. Slip under the bed-confined patient the long auto-condensation pad. Place a large snug fitting pad over the anterior chest. Dosage 1000 to 2000 milliamperes for 15 to 30 minutes. This may be given once daily and has a general auto-condensation effect in addition to its local action. The second method is straight diathermy, with large electrodes on the anterior and posterior chest wall, both electrodes of the same size. In the chronic stage give

in addition to Diathermy fractional doses of the X-ray twice weekly and using blunt focus Coolidge tube, with proper filtration and protection of the patient. Actinic Light should also be employed.

INTERCOSTAL NEURALGIA

Diathermy is indicated to relieve the pain and promote a healthy hyperemia. Place electrodes where indicated and treat for thirty minutes. Skin tolerance.

INTERMITTENT CLAUDICATION

A. Wilson Gill, M.D., of Edinburgh, and L. Newell Moss, M.R.C.S., says: "The onset of the cerebral attacks decided us to try diathermy, especially as we were familiar with the good effects in cases of hypertension. Following the advice of Roeser, Giraud, Vaquez, and others, we gave exposures lasting 30 minutes, the maximum current used being 1000 milliamperes. At first twice a week was considered sufficient, but later he was readmitted to the Royal Infirmary on November 6 and had this seance repeated daily for 20 days as recommended by Roeser and others. Lian and Descoust emphasize that strong currents are not necessary and advise 1200-1500 milliamperes.

"If the plates are sufficiently large there should be a sensation of heat without burning or pain, and the blood thus warmed carries the superfluous heat to the rest of the body. There is probably, therefore, nothing to be gained by having one plaque over the seat of the arterial block."

IRITIS, ACUTE OR CHRONIC

Vacuum or non-vacuum electrodes or metal electrodes may be used in the treatment of iritis. Treat for 30 minutes, using low milliamperage. Approved methods are described on pages 61, 63.

Indirect Diathermy Treatment: Place patient on the auto-condensation pad and connect it to the Tesla post and apply indirect Diathermy, using fingers of the operator for the active electrode.

JOINT INJURIES

See Orthopedics, pages 93, 94.

KNEE JOINT INJURIES

Treatment should be begun as soon as possible after the injury occurs, before edema and swelling have taken place. To be sure, these conditions are by no means a contra-indication for diathermy treatment, but if they can be forestalled, much pain and trouble may be avoided.

Even when the X-rays shows the presence of a fracture diathermy treatment is indicated.

Be careful, in applying the electrodes, to use a bandage that will not become tight as the limb swells. Free circulation is essential.

Employ the diathermy treatment, as described below and on the following pages, at frequent intervals until the edema and swelling have been checked or abated, which may take 36 to 48 hours.

The joint may then be bandaged in the usual manner, and the patient will experience a minimum of pain and inconvenience during convalescence.



*Application of Diathermy
Clamp and Electrodes to
Knee*

Value of Sinusoidal Treatment in Knee Joint Injuries

Three or four days later, sinusoidal treatment may be begun, applying electrodes above and below the bandages and using very light stimulation at first, until healing is well under way. In this manner, fibrosis, ankylosis and muscular atrophy are avoided.

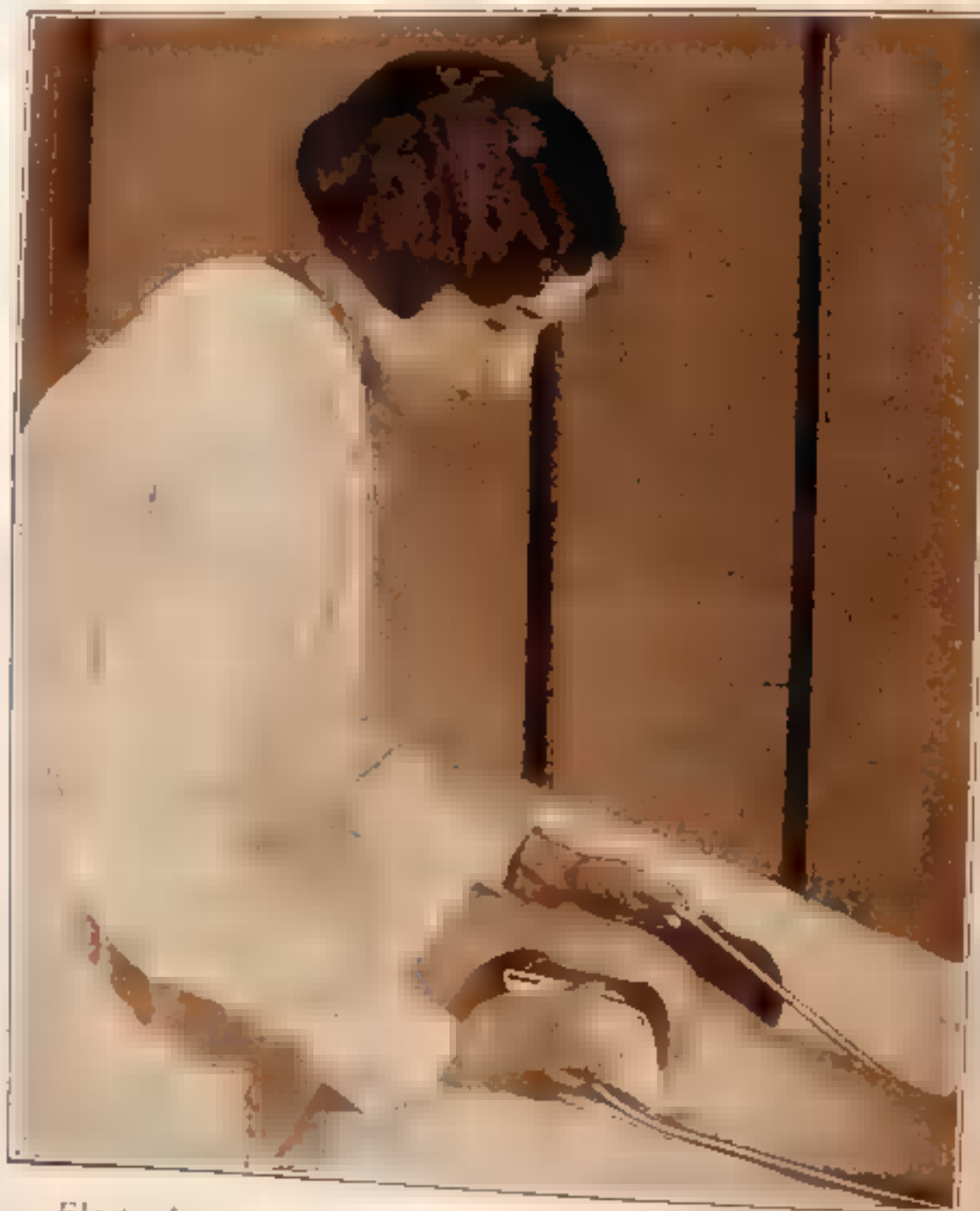
Even in cases first seen several weeks or months after the injury, sinusoidal treatment combined with massage and manipulation will be found of distinct value, as will diathermic heat, applied before treatment to relax the parts.

Charles R. Brooke, M.D., New York City,⁴² uses diathermy in knee joint injuries as follows: The cross-fire method of diathermizing joints is used. The exact technic of the method is carried out by the sequence of four different applications of the electrodes: The first treatment is given by the cuff method, cuff electrodes being placed around the leg just below the patella ligament and around the thigh just about the knee joint. The second application is carried out by placing plate electrodes above and below the knee diagonally opposite each other. The third

⁴²Am. Jour. Phys. Ther., Sept., '24.

treatment is given by reversing the electrodes, and in the fourth and last application, the electrodes are placed one over the knee-cap and the other in the popliteal space. Duration of each application and treatment is 20 minutes, given singly or combined, and repeated as often as indicated.

Ewerhardt says that "Diathermy is a safe heating procedure which can be localized in deep-seated tissues at will; the degree of intensity may be satisfactorily regulated by means of suitable electrodes of varying sizes, properly applied and augmented by the cooperation of the patient. That it is a valuable measure, at least a partial control of pain, spasm, and swelling in the earlier stages of fractures and joint injuries and contributes, therefore, materially to a favorable functional end result."

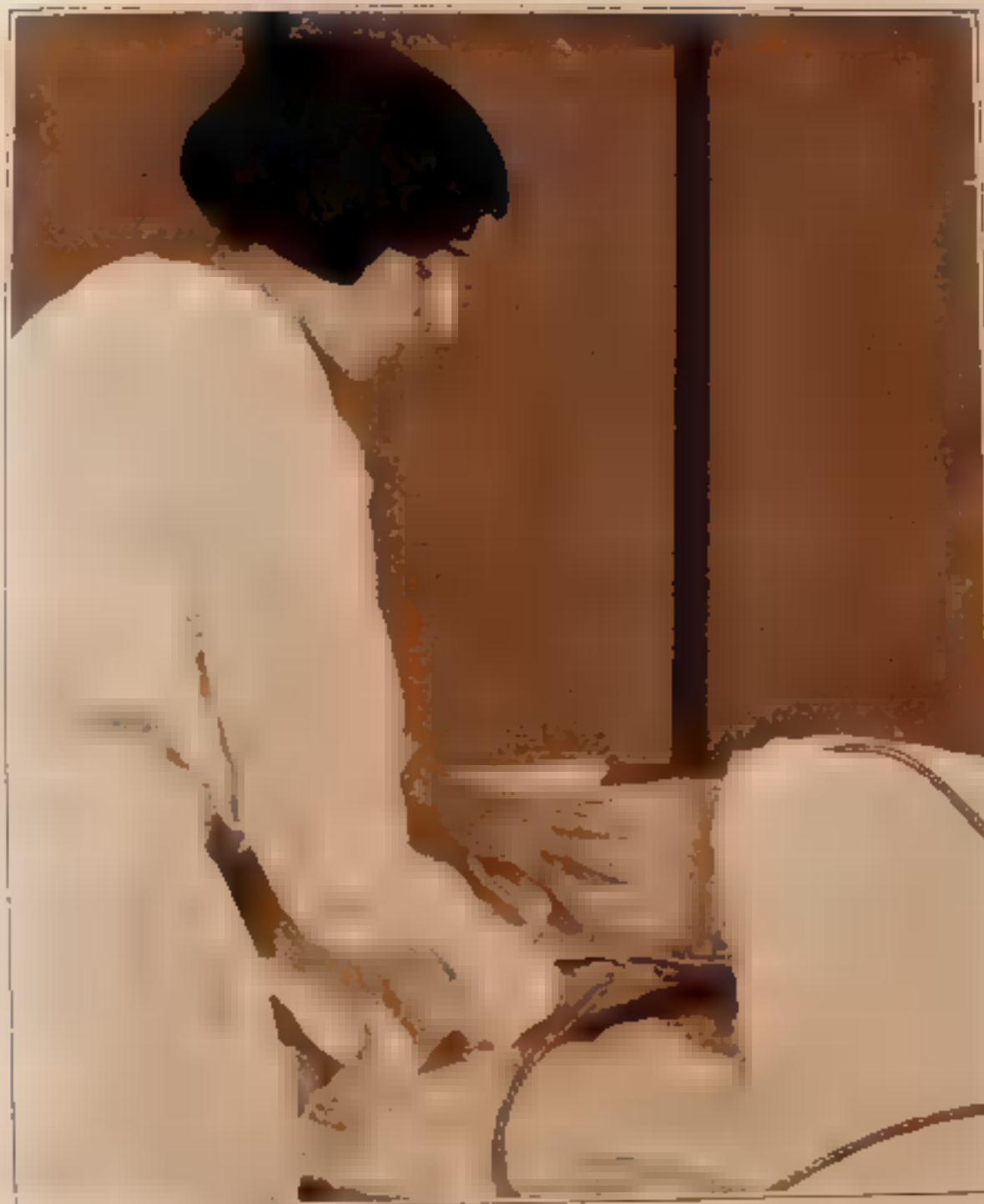


Electrodes applied to either side of the knee and held in place by elastic bandage. 4" x 3 inches. Give 800 to 1200 milliamperes for 20 minutes.

Also, see Orthopedics, pages 93, 94.

LARYNGITIS

Indirect Diathermy may be used with excellent results, the fingers of the operator being used as the active electrode. The fingers conform to the contour of the neck more easily than any electrode. Treat for 30 minutes. This condition is best treated sometimes, superficially, with a non-vacuum electrode over the larynx. Time, 10 minutes daily. Diathermy is especially effective in acute infectious laryngitis.



LUMBAGO

The illustration shows the large tin plate electrode slipped into place under the lumbar region, the other electrode on abdomen; treat for 30 minutes, 1800 to 2500 milliamperes, tolerance of patient.

LEUKOCYTHEMIA

See Anemia, page 30.

LEUKORRHEA

See section on Diathermy in Gynecology, pp. 70 to 74.

LIVER, DIATHERMY TO

Gage Clement, M.D., Duluth, Minn., says, "The liver and the diseases which are peculiar to it are greatly benefited by diathermy, and recognition will soon be accorded it in relation to these maladies. In postoperative shock, especially after cholecystectomy, and in acute depression from any cause, diathermy raises the body temperature. Crile says that 'diathermy to the liver, by raising the body temperature one or two degrees, increases the internal respiration on which life itself depends.' Diathermy is certainly indicated in acute catarrhal jaundice. In a recent epidemic, those patients so treated became convalescent in about one-third the time required by the patients not so treated."

LYMPHADENITIS

Diathermy is of value in the treatment of lymphadenitis. When the inflammation is not very active, physicians often attempt to abort the process by cold applications or by painting the swollen glands with the tincture of iodine. If this fails, or if the glands are actively inflamed, they may be broken down by diathermy, (heat) with the formation of pus, which should be evacuated. Apply an electrode slightly larger than the inflamed gland with a very large inactive electrode on the opposite side of the body. Treat twice daily for 45 minutes, until the inflammation subsides and resolution is established. If suppuration occurs the pus must be evacuated.

MENOPAUSE, NEUROTIC SYMPTOMS OF

These symptoms are due to some effect, not clearly understood, of the interrelated system of endocrine glands on the autonomic nervous system. Auto-condensation will give as valuable a sedative effect in this condition as in hypertension, the two being closely related.

MENSTRUATION, IRREGULAR

See Diathermy in Gynecology, pp. 70 to 74.

MIGRAINE

Diathermy is often very useful in this exceedingly painful condition. Apply small electrodes, or use the fingers for treating

⁴⁶ Paper, Am. Coll. Phys. Ther., June, '28.

about the head at the points of exit of the sensory nerves. Give treatments daily. When the attack is on, only strong anodynes will give any relief. Use a mild current and treat 20 minutes daily.



MYOSITIS

Above is shown application of electrodes for treating traumatic myositis of the extensor muscles of thigh. (*Charlie Horse.*)

Electrodes should be placed slightly more anteriorly than shown in the illustration so as to produce greatest heat in the extensor muscles.

MYOCARDITIS

In the light of our present knowledge of the pathology of myocarditis—that of impaired nutrition—diathermy may be accepted as a rational therapeutic agent. Numerous favorable reports have been received from physicians who have used diathermy in this condition. Almost immediate relief may be expected from the precordial pain or angina, if present, and a general feeling of relief is experienced following the treatment.

Baruch Last, M.D., New York, says¹⁷ that cases of myocarditis of not long standing, accompanied by a feeling of oppression, painful sensations around the cardiac region, and occasional attacks of angina pectoris, are benefited by diathermy treatment.

¹⁷ *Am. Jour. Phys. Ther.*, Mar., '25.

Treatment: Two metal plates of nearly equal size should be used. The slightly smaller one, four by six inches, is placed in front over the precardium, and the larger one, five by eight inches, in the back exactly opposite the first one, the patient being in the prone position. The current applied should not exceed 1000 milliamperes even if the patient does not feel the heat, as the maximum dose is unnecessary and might even be harmful. The duration of the treatment should be from ten to fifteen minutes, never longer.

If it is desirable to send more of the diathermy current through the heart itself, increase the size of your posterior electrode.

Absolute rest in bed at beginning, followed later with graduated exercises.

NERVE INJURIES, PERIPHERAL

Diathermy should be given until nerve regeneration is complete. Apply block tin or mesh electrodes so as to include the affected nerve between them. When regeneration is complete, cease diathermy, as it obtunds the sensitiveness of the nerve to galvanism.

Then use the slow reversing galvanic sinusoidal through the limb from the spine to the extremity; one or two waves per second of an intensity one-fourth of that required to produce muscle contraction on the healthy side for 10 to 15 minutes daily.

Each day, just after the above treatment, stimulate the individual affected muscles, one electrode at the end of each muscle, one impulse per second. Give each muscle three contractions each day. (The muscle will not respond to motor points at this stage.)

When regeneration is complete and motor points reappear, exercise the muscle by motor point stimulation.

Then give passive, finally active motion.

NEURALGIA

All forms of neuralgia response readily to diathermic measures. Apply electrodes to include affected area between them, using two large block tin electrodes. Technic as in Arthritis, pp. 33, 34. Treat as often and as long as is required to relieve the pain, and at the same time seek the cause and treat it by whatever measures indicated. Focal infections such as are found in the tonsils and around diseased teeth should receive attention. Trigeminal neuralgia will usually require, in addition to diathermy, some opiate to relieve the pain.

NEURAL SYPHILIS

Curran Pope, M.D., describes his treatment as follows:

Give an intravenous injection of dextrose, preferably on an empty stomach or two hours after a very light breakfast. Wait one or two hours and then give, in ascending doses, neoarsphenamin. This should be followed by Cerebral Diathermy, one electrode on the forehead, the other on the nape of the neck, dosage ranges from 300 to 600 milliamperes, duration 5 to 15 minutes, immediately followed by galvanism. Careful localization of the lesion must have been made. The negative electrode is placed *nearest* to the lesion and the positive electrode on the opposite side of the skull. Dosage 10 to 15 milliamperes for 5 to 10 minutes. Other physical measures by reconstruction are to be found in hydrotherapy and the Static current. Intramuscular injections of mercury and bismuth are useful.

NEURITIS

Miles J. Breuer, M.D., Lincoln, Nebr., says, "I would advise that diathermy be used in the early stages of the neuritis, before degeneration of the nerve-fiber has taken place; this with the hope of saving the fiber from degenerating, if possible. Supposing that degeneration takes place anyway. Then our problem is different. If the nerve-cell body is intact, the fiber will regenerate, and will do so just as well without diathermy as with it. If the nerve-cell body has been destroyed, nothing will bring back the fiber. Therefore, diathermy is not indicated any further."

Arthur H. Ring, M.D., Arlington Heights, Mass., says,⁴⁸ "For pain, as in neuritis, myositis, cramps, etc., unless due to acute inflammation, diathermy is the remedy."

In all cases of neuritis whether it be of the toxic, traumatic, chronic, interstitial or exudative type, there is some edema and swelling of the nerve itself. This, together with more or less degeneration which follows, is productive of pain and various paresthesias associated. The sensory symptoms may be mild or severe, depending upon the extent of the inflammation and degeneration. The degenerative process may extend from the periphery upward involving the spinal cord, or even the brain.

Diathermy is of distinct value in relieving the edema and swelling and consequently preventing the pain, also in hastening the absorption of any exudate and assisting resolution by producing a marked hyperemia of the parts treated, all of which favors repair. In chronic cases the static wave current alternated with diathermy is of value to remove infiltrations and exudates.

⁴⁸ *Int. Jour. Med. & Surg.*, Mar., '28.



NEURITIS, BRACHIAL

Medical diathermy. Note that position of posterior electrode is over the lower (4th, 5th, 6th, 7th and 8th) cervical and upper dorsal vertebrae, while the anterior electrode is placed well to the outer side of chest and over upper part of arm. The current then traverses region occupied by brachial plexus. Treat for 20 to 30 minutes, with from 500 to 1000 milliamperes, according to patient's condition and tolerance.



NON-VACUUM ELECTRODE

See page 61.

NOSE, DIATHERMY TO

At Left:—Treating nasal mucous membrane by indirect method. Patient is seated on the auto-condensation pad which is connected to the high voltage binding-post (monopolar) of the Fischer High Frequency machine. Holding a nasal non-vacuum electrode in contact with the area to be treated, the operator applies the current. The current is then drawn from the patient's body through the electrode to the operator, who acts as a "ground" to the current.



Above:—Monopolar diathermic treatment of nose. Special nasal electrode. Set for $\frac{1}{8}$ in. spark or less, treat for 10 to 15 minutes, each nasal chamber. This method of treatment has been used rather extensively in asthma and hay-fever, coryza, and all so-called "catarrhal" conditions of the nasal mucous membrane.

ONYCHIA

Treat as constantly as practical until condition is overcome. The air-cooled ultra-violet lamp is used in conjunction with diathermy. Onychia is frequently a sign of systemic debility. The patient should be examined thoroughly from head to foot. Anemias, tuberculosis, severe infectious fevers, carcinoma, are frequent etiological factors.

ORCHITIS

See Epididymitis, page 62.

OSTEOMYELITIS

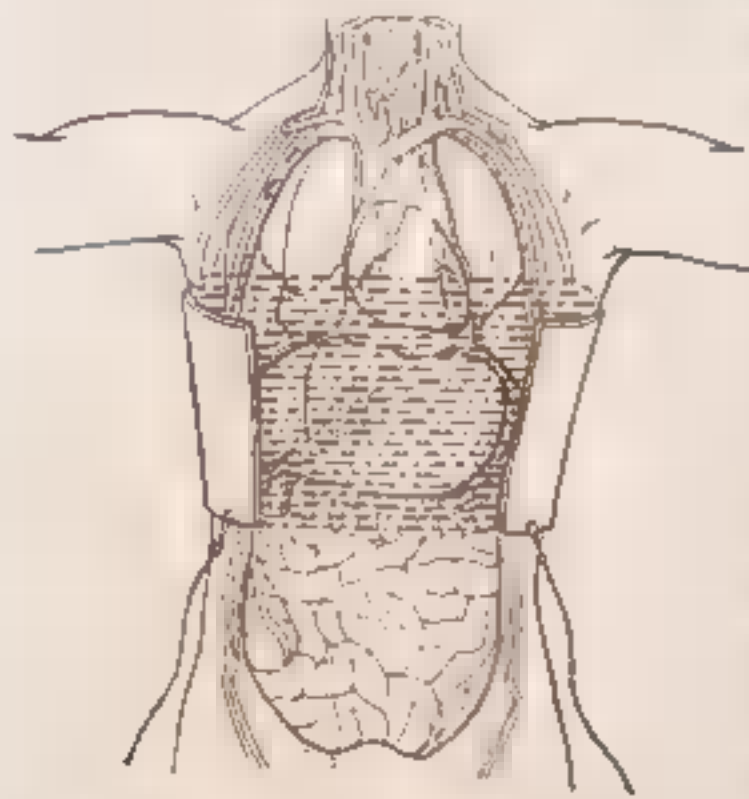
See article on the treatment of Tuberculous Osteomyelitis, page 123, for technic. In acute streptococcic or staphylococcic osteomyelitis, drainage must be established as quickly as possible. Diathermy is extremely valuable in the treatment of these conditions.

OPERATIONS. ABDOMINAL.

Abstract of an article by G. W. Crile, M.D., on The Use of Diathermy and of the Quartz Lamp for Conserving the Temperature of the Viscera and Promoting the Welfare of the Patient Before and After Abdominal Operations.

It was apparent to Dr. Crile that the only satisfactory method of preserving the normal temperature of the liver during operation would be by the employment of some system which would "heat through" the tissues, more particularly the liver, without unduly affecting the outside surface. The principles of diathermy at once suggested themselves.

Diathermy, which consists of the passing of a current of high frequency through the body of the patient, has the property of heating the subcutaneous tissues without affecting the external parts in contact with the electrodes of the apparatus. Dr. Crile felt that if one of the diathermy electrodes were placed upon the lower chest on one side and the other electrode brought opposite the dome of the liver, then the current would pass through the upper abdominal organs, including the liver. Now, if this current could be continuously applied throughout the operation, the temperature of both liver and abdominal viscera in general would be maintained at or above the normal, regardless of the exposure of the intestines.



Above illustration shows effect of Diathermy current as used for "heating through" the entire field during an abdominal operation, according to Dr. Crile's method.

Dr. Crile also points out that on account of the enormous spread of the capillaries, veins and arteries very near the surface of the viscera, the blood in the whole splanchnic area almost immediately assumes the temperature of the air to which it was exposed. By the passing of the diathermy current through the liver and the neighboring viscera, this thin layer of blood would, as it were, be made to pass over a hot table so that warm blood would pass into the rest of the circulation.

In accordance with this conception, Dr. Crile and his associates have been applying the diathermy current in certain bad risk cases. They have found that the electrodes can be put in place and the diathermy current established before the abdominal incision is made and that neither the surgeon nor the patient need be aware that such a current is passing. By actual observation it has been found that the temperature of the dome of the liver can be maintained above normal throughout an extensive operation in which the abdominal viscera are widely exposed.

In Feeble and Aged Patients it has been observed that a higher incidence of pneumonia takes place following abdominal operations than after other operations of an equal magnitude.

As a possible explanation of this occurrence, Dr. Crile advances the theory that cooling of the liver results in a general depressed function of the organism together with cooling of the blood in the important organs within the chest wall. He and his associates are, therefore, now noting the effects of diathermy in lessening the incidence of post-operative pneumonia.

In feeble and aged patients after especially wide and prolonged exposure of the upper abdomen, repeated doses of diathermy are delivered through the bases of the lungs. In addition to the advantage of heat to the part, the increased temperature must tend to bring about a more active circulation in this area and thus increase the natural defense against infection.

ORTHOPEDICS

F. H. Ewerhardt, St. Louis, Mo., says:⁴⁹ (1) That diathermy is a safe heating procedure which can be localized in deep-seated tissues at will; the degree of intensity may be satisfactorily regulated by means of suitable electrodes of varying sizes, properly applied and augmented by the cooperation of the patient; (2) that it is a valuable measure, at least a partial control of pain, spasm, and swelling in the earlier stages of fractures and joint injuries and contributes, therefore, materially to a favorable functional end result; (3) that patients take kindly to it, are favorably impressed with the procedure, and their cooperation is more easily secured where movements and massage are indicated; (4) that unquestionably the period of convalescence in the treatment of fractures is materially reduced; (5) that its application seems indicated in postoperative bone and joint conditions, acute sprains, fractures, and bursitis; acute and chronic arthritis, and contractures, fibrositis, and myositis ossificans."

⁴⁹ Paper, Annual Meeting, A. M. A.

R. W. Fouts, Omaha, Nebr., summarizes the value of physical therapy treatment of bone and joint injuries, as follows: "(1) Diathermy is of value in bone and joint injuries and should be used early. It relieves muscle spasm, prevents edema and lessens pain; (2) by controlling edema and swelling, further traumatizing of tissue and the resulting fibrosis is prevented; (3) fibrosis of soft tissues may be prevented by early employment of electrical stimulation. If continued and increased in strength will prevent atrophy of the muscles; (4) in cases of long standing with fibrosis and ankylosis diathermy is of value, preliminary to massage and manipulation; (5) small doses of X-ray assist in the absorption of scar tissue; (6) massage and manipulation consistently employed are of greatest value in cases of old standing.

A. Gonnet concludes²⁰ that diathermy is an agent of the first order, to use in various joint diseases, especially where pain is the chief symptom, and deserves to be tried, be it at first or after other methods.

P. H. Kreuscher, M.D., says:²¹ "The use of diathermy is of great value in reconstruction work where fixations of muscles, tendons and joint capsules are to be overcome. In any chronic condition where maximum heat is indicated diathermy is the method of choice."

A. O'Reilly, M.D., says:²² "In stiff and painful joints, heat, used before massage and manipulations, has proved most useful. The author has been using diathermy immediately before a forcible manipulation under an anesthetic. In infantile paralysis heat is useful in all stages. In the acute stage baking and diathermy are soothing and beneficial. In non-purulent gonorrheal arthritis radiant heat and diathermy are valuable aids to treatment."

Frank H. Walke, M.D., says:²³ "Diathermy is invaluable for injuries to bones and the periosteum. Acute periostitis, following trauma, is very painful and, without diathermy, the soreness remains for a long time. Diathermy, however, will relieve the pain and cause the soreness to disappear quickly. In cases of fracture, diathermy, if begun early, will stimulate callus formation and a firmer union will result. And in ununited fractures, where callus is slow in forming, diathermy will hasten it. Diathermy will also do more to cure ununited fractures than operation, provided no foreign material lies between the fragments."

Also, see Knee Joint Injuries, pages 83, 84.

²⁰Jour. de Med. de Paris, Aug. 9, '26.

²¹Arch. Phys. Ther., X-Ray, Rad., Apr., '27.

²²Arch. Phys. Ther., X-Ray, Rad., May, '27.

²³Surge. Jour., Jan. Feb., '27.

OTITIS MEDIA

In acute otitis media radiant heat-light is the agent which affords relief and often aborts complications. Diathermy should not be applied in acute cases in which drainage has not been effected. After paracentesis or spontaneous rupture of the drum membrane, diathermy is of great value. A small block tin electrode, cut so as to fit over the ear and mastoid on the affected side, and a large indifferent electrode over the face on the opposite side, may be employed as an improvised method. Diathermy may be administered through the ear canals, but this method is of doubtful value. The method of choice involves the use of the headband and special electrodes. Treatments should be given for 20 to 30 minutes; between 250 and 300 milliamperes are sufficient, and treatments may be repeated once every twenty-four hours. This same method is of decided value in chronic catarrhal otitis media where the opening in the drum membrane is of sufficient size to permit good drainage. In acute cases, radiant heat-light should be used between the intervals of diathermy treatments.

OVARIAN NEURALGIA AND OVARITIS

Diathermy is indicated for relief of the pain. For technic, see section on Diathermy in Gynecology, pages 70 to 74.

OZENA

See Nasal Catarrh, page 50.

PAPILLOMA OF THE LARYNX

Walter Hesse⁵¹ favors the combining effect of surgical excision and the diathermization of the base of the wound. He attributes his good results to the combination of both procedures. The value of surgical diathermy is due to the fact that it immediately helps to seal off the blood and lymph vessels by coagulation. This should be extended some distance into the healthy tissue in order to avoid metastasis of tumor cells.

PARESIS

For successful treatment with diathermy, says Drs. Neymann and Osborne,⁵² properly constructed fenestrated electrodes, a machine powerful enough to give sufficient energy, and proper insulation of the patient, are required. Insulation of the patient is accomplished by means of seven blankets and one rubber sheet.

⁵¹ Deutsche Med. Wochenschr., Aug., '30.

⁵² J. A. M. A.

The electrodes are held in place with a close fitting jacket. When extensive areas of a patient are treated for long periods with large amounts of current, ranging between 4,000 and 6,500 ma., varying resistances are encountered depending largely on body thickness. The entire back must be covered by one electrode and the entire chest and abdomen by another. The region just above the iliac crest is the thinnest part through which the current will have to travel, and here burns are most likely to occur. With milliamperage below 4,000 this can be disregarded, but above this figure it is necessary to shunt a rheostat into the circuit, so arranged as to pass two-thirds of the current through the chest and one-third through the abdomen.

PERIOSTITIS

Diathermy is effective in the treatment of this condition. Give daily treatments of 30 to 60 minutes' duration. Treat to skin tolerance. Apply large block tin or mesh electrodes to include affected parts between them.

PHARYNGITIS

Pharyngitis sometimes yields to the application of diathermy locally to the neck. This can be performed with vacuum or non-vacuum electrode. The ideal treatment, however, is to irradiate the pharyngeal cavity with ultra-violet light from the water-cooled lamp, using suitable quartz applicators.

PLEURISY

In this disease, as in pneumonia, diathermy treatment directly *through* the affected area is used. Excellent results have been attained in the various types of pleurisy, relief of pain and dyspnea being afforded by each treatment. Technic is similar to that used in the treatment of pneumonia. Two large mesh electrodes, or tin plate electrodes, are so placed as to include the affected area between them. In applying the electrodes, use sufficient warm soap lather to insure perfect contact, and warm the electrodes before applying to the skin.

The current is turned on gradually and raised to the point of tolerance, remaining at that point from 20 to 30 minutes, then gradually turned off. Milliamperage will be from 1700 to 2000 at the maximum, although in some cases less may be sufficient.

Where there is marked effusion diathermy may be employed after proper drainage has been established. It must be borne in mind that the heat produced within the affected tissues them-

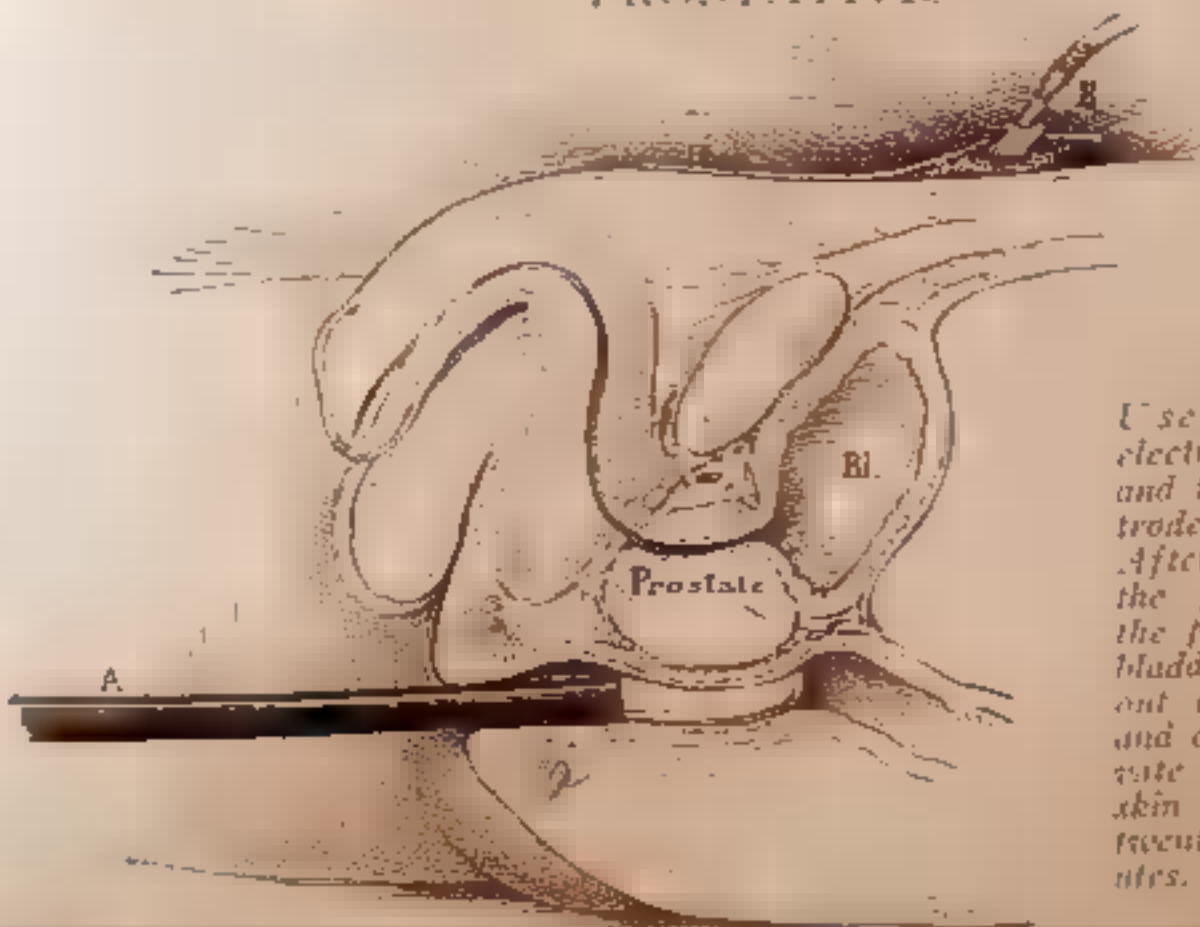
selves by diathermy, promotes increased metabolism. Diathermy should be an aid to the absorption of the effusion.

Care must be taken to prevent the electrodes from slipping or becoming detached during the treatment, which would cause sparking and might burn the patient's skin. Do not depend on the weight of the patient to hold the posterior electrode in place. A firm elastic bandage will ensure perfect contact of both electrodes.



Pleurisy: Electrodes being placed for treatment of right lung area; other plate under back.

PROSTATITIS



Use special prostatic electrode in the rectum and the indifferent electrode over the pubis. After treatment massage the prostate and have the patient evacuate the bladder. This washes out all waste products and cellular debris. Elevate the amperage to skin tolerance and treat twenty or thirty minutes.

PNEUMONIA

Harry Eaton Stewart, M.D., New Haven, Conn., in discussing the treatment of pneumonia by diathermy, says: "In only a few cases has the length of the disease been shortened, but the symptomatic relief and apparent lessening in mortality certainly justifies its employment in this disease. The value of this measure is enhanced by the fact that no other individual measures need be postponed or omitted because of its use, and it can be started immediately without waiting for typing. It is apparently equally efficacious in all cases of pneumonia including streptococcus infection, and in skilled hands seems absolutely safe. We have treated many children under one year of age, some as young as six months. Our plan is to cut electrodes to fit the chest and give about 30 M.A. per square inch. Children as a rule respond beautifully. A thorough clinical trial of this measure is advised to all who understand the technic and administration of diathermy."

N. J. Seybold, M.D., Toledo, Ohio, says:²⁵ "Diathermy when properly administered in pneumonia with regard to other conditions, is devoid of danger. It is never an antagonist, but always an ally. It is the only measure that will place heat with safety and uniformity between two equal surface contacts. Heat used as a therapeutic measure increases the local tissue resistance, increases cell metabolism, increases cell nutrition, and increases blood supply to the part, thereby effecting the absorption of unorganized exudates. The blood pressure, systolic and diastolic, falls slightly after a diathermy treatment in pneumonia. The respiratory rate becomes slower and cyanosis is decreased. I have noted in some of the pneumonias that cyanosis disappeared within ten minutes after beginning treatment."

Dr. Eldridge, St. Elizabeth's Hospital, Washington, reports that in 250 pneumonia cases to which he applied this diathermy treatment, only three resulted in death.

R. P. Forbes reports²⁶ that the percentage of complications of pneumonia was strikingly less in the series receiving diathermy treatment. These results indicate that diathermy should be considered a valuable adjuvant in the treatment of pneumonia.

Adolph A. Lilien and Joseph Echtman, New York, says:²⁷ "Diathermy is indicated in acute pneumonia, acute grave pneumonia, lobar as well as lobular (Broncho-pneumonia), unresolved pneumonia, chronic bronchitis, asthmatic bronchitis and in some cases of pulmonary abscess with drainage."

²⁵ *Med. Jour.*, Mar., '28.

²⁶ *Arch. Pediatrics*, June, '27.

²⁷ *Med. Jour.*, & *Co.*, Jan. 13, '26.

H. D. Offutt, Major, M.C., in discussing the treatment of pneumonia by diathermy, says: "The heat produced also relieves the pleuritic pain, allowing more comfortable expansion of the chest with deeper breathing, better oxygenation, relief from oppression and cyanosis and the patient often falls asleep. Heat also tends to dilate the blood vessels, allowing an increased blood supply to the involved area, thereby giving a better supply of white cells in the early stages and increasing the rapidity of resolution in the later stages."

While it is accepted as a fact by many physicians that pneumonia runs its course uninfluenced by medicine, the results obtained by those using diathermy indicate that during the first stage congestion may be dissipated by this treatment, and that the second and third stages can be very favorably influenced by its application.



Diathermy Treatment of Pneumonia

Technic

Dr. Harry Eaton Stewart says, regarding technic:

"The development of the portable diathermy apparatus to a very high degree of efficiency makes it possible for the physician, today, to give accurate and effective diathermy treatments in the home of the patient.

"Diathermy is given by means of a portable apparatus sup-

plied with a milliamperere meter and capable of delivering 2000 milliamperes of current.

"For electrodes we usually employ the flexible composition metal (block tin) in sizes considerably larger than the involved areas, with edges turned over and rolled flat. This technic had led to a distinct lessening in the number of extensions to adjacent lobes. When it is necessary to treat two non-adjacent lobes, plates of the size for a single lobe treatment are employed and two separate applications of the current are given. The anterior electrode may be of flexible chain material when there is any great irregularity in the contour of the chest. The preparation of the electrodes consists in warming them thoroughly and covering them with warm, thick soap lather before applying them to the skin. The posterior electrode, clipped to the cord, is placed on a folded bath towel, the mattress depressed, and the electrode slid under the patient to its proper position without disturbing him. An additional towel or small pillow may then be crowded under it to insure good contact. The chest electrode may be gently held in place by the tips of the operator's fingers or secured with adhesive strips. Sand or shot bags and circular constrictions are to be avoided, if possible. When the patient is restless, irrational or coughing heavily, good contact must be secured in any event.

"With everything in readiness, the current is turned on slowly and gradually, employing about five minutes to reach maximum of 1500 to 2500 milliamperes. This maximum may be maintained for 30 minutes or longer, and then turned slowly and completely off. When patients are restless the cords must be so placed that it will be impossible for them to be pulled loose. In very severe cases treatment may be repeated every alternate hour. In the usual case treatments every three hours are sufficient, omitting one in the early morning. With the onset of resolution the treatments can be rapidly cut down, both in amount and frequency. In the treatment of children the size of the chest should determine the proper electrodes to choose, and a current of not over fifty milliamperes per square inch of the electrode surface given.

"The cumulative experience of the profession in the treatment of this disease has taught caution in placing faith in any one method of treatment. Innumerable methods have been tried and discarded in an attempt to lower the heavy mortality incident to lobar pneumonia.

"Clinical investigation of the effect of diathermy in lobar pneumonia offers certain advantages. Among these are:

"a. It is available wherever electricity is installed.

"b. It requires no cumbersome or very expensive apparatus.

"c. The technic of its application, while exacting, is neither very difficult nor complicated.

"d. Not a single untoward effect has followed the giving of some 1,900 treatments reported to date. We may therefore feel assured that, properly given, it is absolutely safe.

"e. No other part of the entire treatment regime of the patient, even including the use of serum, need be postponed or contra-indicated when diathermy is employed."

"f. Unlike certain other medical and surgical procedures, it has not proved its value almost wholly in the hands of one individual or institution. The writer is glad to acknowledge that a number of his co-workers have obtained a lower mortality in the treatment of their cases than he has in his own. He feels certain that what they have done may be equaled or surpassed by the profession at large."

POST-OPERATIVE PULMONARY CONDITIONS

N. J. Seybold, M.D., Toledo, Ohio, says:⁴⁸ "My first thought in postoperative lung conditions is diathermy. Over 95 per cent show immediate improvement, barring other complications."

PROCTITIS

Apply mesh-sponge to anus with large block-tin electrode over abdomen. Elevate the current to the skin tolerance and treat for 30 minutes daily. The perineum should be shaved and soap lather applied to prevent sparking. Treatment is quite effective.

PYORRHEA ALVEOLARIS

C. E. Norris, D.D.S., Indianapolis, Ind., says:⁴⁹ "In the treatment of pyorrhea alveolaris, tumors, cysts, pyogenic membranes, abscesses, etc., in the mouth coagulation offers several advantages over the well-known surgical, medicinal and mechanical methods now employed. (1) It is practically never necessary to do more than one operation; (2) most of the operations may be done under local anesthesia; (3) the instrument sterilizes as it cuts, thus tending to make the wound aseptic; (4) Hemastasis—no time is lost in the ligation of vessels as the current seals blood and lymph vessels; (5) postoperative pain is practically nil due to obtunding of the sensory nerves; (6) healing is very rapid

⁴⁸ *Am. Jour. Phys. Ther.*, Apr., '30.

⁴⁹ *Am. Dent. Surg.*, Apr., '28.

and scar tissue is relatively small with this method.

Treatment: When employing diathermy electrocoagulation, one terminal, which we will call the indifferent electrode, should be placed somewhere on the patient's body, care being exercised that this electrode is well fitted to avoid burning. The active electrode is used in the field of operation. This is ideal in the treatment and excision of large growths in the mouth and for large areas of infection and osteomyelitis of the mandible and maxillary bones. The active electrode in this procedure may be a needle, curette or blunt instrument. It is far better to use too little current than too much in the average case."

RENAL DISEASE

Curran Pope, M.D., describes his treatment as follows:

In nephritis and kidney infection physical measures have been found of proven value. In renal infection the blood stream, filled with bacteria, principally colon bacilli, or with toxic products irritates the kidney and produces a "pre-nephritis." The kidney eliminates toxic products and bacteria themselves. In this state general measures, especially auto-condensation, is valuable. The quartz or arc lights, or what is better, a combination of the high wattage 1500 C.P. incandescent lamp, at the same time that an arc lamp, with iron cored carbons, followed by method of using the Aix-la-Chappelle or manipulation douche will do much to clear the blood stream and relieve kidney irritation. Colon drainage is beneficial. **STATIC:** Give heavy sparks to spine and over liver. Follow with wave current, using two large Leyden jars, with large pad over kidney region for 10 to 20 minutes. *Diathermy* is a valuable method in kidney disease. In the acute case in bed we should use smaller amperage and shorter duration of treatment, and if necessary give the treatment twice daily. In the convalescent or ambulant patient heavy doses are indicated. A dosage of 1000-1500 milliamperes for 15 or 20 minutes is preferred, rather than a much longer time at a lower milliamperage.

Gage Clement, M.D., Duluth, Minn., says:" "Acute and chronic inflammation of the kidneys may be treated without hesitation with diathermy. Such treatment of these organs must not supplant the usual regimen, but must be used as an adjuvant. Renal calculi with hydrops and hemorrhage are not a contra-indication to diathermy, since many reports have been made of stones that have passed more readily as a result of the relaxation that diathermy affords. Cystitis is another disease in which diathermy is indicated."

^a *Paper Am Coll Phys Ther*, June 9, '28.

RECTAL DISEASES

George J. Ott, M.D., Boston, Mass., says: "The pathology varying in degree and kind, as well as location, will require a different selection and combination of modalities. This is self-evident. Mild diathermy applied by means of a metal electrode 4 x 7 inches, over the sacrum or the abdomen, and a metal electrode 2 inches in circumference and 4½ to 6 inches long (preferably hollow) in the rectum, each electrode being attached by a cord to opposite poles, with a current of from 400 to 800 M.A. passed through the pelvic area, will give decided relief in most cases of itching and burning that are so annoying, as well as many concomitant symptoms referred to distant organs. . . . Proctitis calls for diathermy, with the metal electrode inserted."

See also Anus, Fissure of.

RHINITIS

Diathermy is of value in treatment of this condition. For technic see pages 90, 91. Treat 5 to 15 minutes, using either vacuum or non-vacuum electrode and only sufficient current to produce a sense of warmth in the inflamed mucous membrane.

SACRO-ILIAC ARTHRITIS

Diathermy treatment is effective. Use large block-tin or mesh electrode under hips and a similar electrode on the anterior surface above. See page 120 for application of electrodes. Treat at skin tolerance for 30 minutes or more, daily or twice daily.

SALPINGITIS

See Diathermy in Gynecology, pages 70 to 74.

SCARS

Painful scars may be treated by diathermy. For application of electrodes, see Adhesions, page 28.

SCIATICA

R. J. Behan, M.D., Pittsburgh, Pa., in his paper entitled "Physical Measures in the Treatment of Pain," says: "Diathermy gives great benefit in sciatica. The weak current is more effective than the strong current, especially in the early stages. Sometimes the pain is temporarily increased as soon as the diathermy is applied. Pressure upon the nerve should, of course, always be avoided, and any irritating contacts with the terminal areas where sensation is more acute should be avoided."

The current may be passed anteroposteriorly through the upper part of the nerve by putting one electrode over the sacro-sciatic notch and the other directly opposite it on the anterior

surface. Or, it may be passed down the nerve with one electrode over the sacro-sciatic notch and the other a cuff below the lowest point of pain on the leg. Treat at skin tolerance for at least 30 minutes daily or twice daily. If the pain extends the full length of the leg, treat in sections. The custom of placing one electrode against the hip and another on the ankle or sole of the foot is to be condemned as the resistance of the great amount of tissue to be traversed reduces the diathermic effects to a degree where no benefit is derived from the treatment.

SCLEROSIS, DISSEMINATED

Burton Baker Grover, in his "High Frequency Practice," says: "Up to the present time no treatment has proven of avail for sclerosed areas in the brain, but for those in the cord a modicum of relief has been found in diathermy. For technic of application we are indebted to Bergonie, who used two bare metal electrodes, one to the cervical region, the other to the lower dorsal, with a current of toleration of 20 to 40 minutes' duration.

"Bergonie's technic has been modified by Americans who have placed one bare metal electrode 2 x 8 to upper dorsal region, the other 6 x 8 to the epigastrium. A current of tolerance is allowed to flow from 30 to 40 minutes."



SHOULDER,
DIATHERMY
TO

At Left—Diathermy application to shoulder for concentrated heat treatment. 300 to 400 milliamperes, patient's tolerance, for 20 minutes.

SINUS DISEASE

Charles R. Brooke, M.D., states:⁶¹ (1) Experience shows the early use of diathermy to prove that sinus disease can be eradicated before the involved structures are irreparably damaged;



Applying Diathermy to frontal sinus by means of head band

(2) the use of diathermy in sinus infection has shown a degree of recovery resulting that frequently surpasses all expectation; (3) diathermy with other physical measures combined or singly applied in sinus disease, has, to some extent, replaced the older measures of treatment; (4) many cases have shown that a prompt adequate relief can be obtained by the use of diathermy in otherwise seemingly incurable sinus conditions, and this has brought about much appreciation from patients who have availed

themselves of this effective form of treatment.

T. Howard Plank, M. D., San Francisco, Calif.,⁶² in commenting on inflammatory conditions of sinuses accessory to the nose, says: "Diathermy is also invaluable in many cases of sinusitis. It reduces the inflammation and either destroys or reduces the vitality of the infecting organism."

Drainage is the first essential. This may be established surgically, by shrinkage, or by the use of positive galvanism, using a probe wound with a little cotton and dipped in 1/1000 solution of adrenalin hydrochloride. Insert the probe, attach to the positive pole of the galvanic current and connect the negative to a large indifferent electrode on the cheek. About three milliamperes of current is used, for five minutes. The current is then turned off slowly and the probe removed. The pus and mucus will come out on suction then, as a rule. This may be followed by diathermy, with one electrode in contact with supra-orbital region, and the indifferent electrode on the nape of the neck. Treat for 20 minutes.



Applying Diathermy to Antrum

A. R. Hollender, M.D., says:⁶³ "Medical diathermy is of value in acute and chronic forms of frontal and maxillary sinusitis, but must be employed with due regard for underlying factors, principally that of drainage when suppuration is present."

SKIN BLEMISHES, BENIGN

The treatment of benign skin blemishes includes a wide variety of minor operations which are logically a part of the surgeon's work, but which frequently are neglected or ignored by the general practitioner. Surgical diathermy offers the ideal means of treatment, combining in greatest degree all the requirements of the operator.



Fig. 1. Drawing showing the needle applicator held a short distance away from the skin, a shower of sparks passing to the lesion.

Surgical diathermy is applied easily and quickly, is under such perfect control that even the eyelid may be operated safely, is

bloodless, leaves the least possible scar and calls for little after-treatment. It is suitable for all the following conditions:

Moles
Warts
Papillomata
Sebaceous Cysts

Spider Nevus
Small Angiomata
Telangiectases
Tattoo Marks

Boils
Localized Skin
Infections

Preceding the application of surgical diathermy, the skin should be first carefully sponged with alcohol and then dried. Local anesthesia is utilized according to the surgeon's own technique, and the skin again dried. After anesthesia is attained the operation proper is performed.

When the lesion is small, the monopolar method is used, with the current passing from the machine to the patient and thence to the ground. For larger lesions, use the bipolar method, with the current passing from the machine through the active electrode to the patient and thence through the inactive electrode back to the other pole of the machine. For the active electrode, a needle point electrode is used. For the inactive, the operator may use a large piece of block-tin, affixed firmly to patient's back or chest; or the patient may hold the auto-



Fig. 2. Needle applicator inserted into lesion. Multiple punctures such as this are made until entire base is coagulated.

An excellent method of dealing with these small skin lesions is to grasp the lesion in a pair of artery forceps which is connected to one of the d'Arsonval terminals, and plunge into it a needle connected to the other terminal. Thus the current and its destructive effect are confined to the portion held by the forceps, and do not extend into undesired areas.

At Right—Unipolar current used for removal of benign skin blemish where the latter is very small. Patient holds autocondensation handle in hands. Operator uses small needle electrode with just sufficient current to produce spark. Use foot switch for instant control.



Sebaceous cyst arising from the lower eye lid near the margin. Successfully removed by surgical diathermy.

When the lesion is small and superficial, the needle electrode should be held about one millimeter away from the skin, allowing the current to spark across from the electrode to the lesion. The electrode should be moved about to avoid the danger of leaving pits where deeper destruction is effected. (Fig. 1, p. 106.)

Where the lesions involve the deeper layer of the skin, as in warts, it is preferable to push the needle into the tissue at one point at the base and coagulate, repeating this process until the entire wart has been treated. (Fig. 2, 106.)

For small lesions, no dressing is necessary and the patient may wash the face as usual. If an exudate occurs under the coagulated tissue it should be drained.



Multiple warts on palms of both hands. Successfully removed by surgical diathermy.

SKIN BLEMISHES, BENIGN - Continued

Right—Injecting local anesthetic.

Center—Coagulating with the needle - point electrode.



Left — Coagulated area after operation is completed.

SKIN, PIGMENTED GROWTHS OF

A. Benson Cannon, M.D., New York, says: "The congenital nevi irregular in shape, color and surface markings and the acquired type occurring in the popular form are usually the types that give rise to melanocarcinoma, and should be radically removed with the surgical diathermy knife as soon as they make their appearance, the wound being left open to granulate.

"Where the lesion is removed early and thoroughly in this manner, I believe that there is very little likelihood of the development of a melanocarcinoma. Any lesion that shows evidence of growth, change in color, surface markings, irritation or ulceration should be immediately and radically removed.

Of three cases of proved melanocarcinoma removed with the surgical diathermy knife by wide excision of the growth and the wound left to granulate, there has been no evidence of recurrence in 6½, 5½ and 5 years, respectively. A fourth case in which a tumor was removed 4½ months ago is also free from evidence of metastasis."

SKIN TUMORS

Dr. Richard Vallack, of Sydney, Australia, states⁵⁴ that the desirable factors for a method of treating neoplasms of the skin are: (1) Certainty of eradication; (2) minimal destruction of adjacent healthy tissue; (3) minimal resultant scarring; (4) minimal hemorrhage; (5) minimal postoperative pain; (6) speed in operating; (7) minimal resultant shock. In diathermy, properly applied, we have a method that fulfills these aims in a manner more certain than does any other technic at our disposal.

"It is of the greatest importance to use a powerful and thoroughly reliable apparatus, designed for thermopenetration.

"The methods for attacking the new growths are: (1) Electrodesiccation; (2) fulguration, or high frequency cauterization; (3) electrocoagulation."

Grant E. Ward, M.D., Baltimore, Md., says:⁵⁵ "Electrothermic methods are powerful adjuncts to the radiologist in removing slowly healing sclerotic ulcers which may or may not contain active growth."

See, also, Cancer, pages 41 to 48.

SPRAINS

Diathermy is quite useful in the treatment of sprains, it relieves the pain, hastens absorption, accelerates repair. For application of electrodes, see section on the part to be treated; wrist, ankle, elbow, etc.

SUPRA-ORBITAL NEURALGIA

Diathermy is often very useful in this condition. Apply small electrodes, or use the fingers for treating at the points of exit of the sensory nerves. Use a mild current, and treat for twenty minutes daily. Supra-orbital neuralgia may be caused by a rhinitis or sinusitis.



TIC DOULOUREUX

Above:—Block tin indifferent electrode, shaped to under side of face. Active electrode is disc, held by operator. Toleration milliamperage for 15 minutes.

TONGUE. CANCER OF

(See Cancer of Tongue, Page 43)

TONSIL TREATMENT

Physicians who use Diathermy in tonsil infections claim a degree of success equal to that achieved in tonsillectomies, together with greater ease of operation and less discomfort to the patient. The diathermy operation is bloodless, the diseased parts are sterilized because the current used is germicidal, and singing and speaking voices are not impaired.

The patient may go about his business the same day, and the after-soreness, which is slight, will disappear within a very few days.

Frank J. Novak, Jr., M.D., Chicago, says,⁶⁶ "This conservative technic is far safer than the more rapid and, therefore, more radical method. It may then be said that because of imperative economic necessity electrocoagulation of the tonsil in some patients is a necessity. In cases of poor operative risk it is the operation of choice. For the destruction of small post-operative remnants of tonsil tissue there is no better method than electro-desiccation.

It is a valuable adjunct among the procedures available to the tonsillectomist. The progressive otolaryngologist instead of regarding it as a negligible novelty will use it in properly selected cases."

A. R. Hollender, M.D., Chicago, summarizes that "Surgical Diathermy, either as electrodesiccation or as electrocoagulation is a desirable and satisfactory procedure for the destruction and ultimate disappearance of recurrent lymphoid tissue."

Frederick B. Balmer, M.D., Chicago, says,⁶⁷ "There have been numerous objections to electrocoagulation. The technical application and the type of current employed were probably at fault. While no attempt is being made to replace surgical tonsillectomy by the electrosurgical procedure, it should be emphasized again that the latter has distinct merit in properly selected cases."

Indications

Dr. Balmer says,⁶⁷ "The indications for electrocoagulation are:

"1. Postoperative tonsillar remains, lymphoid hypertrophy, or regenerated tonsillar tissue. It is generally conceded by those having had experience in electrosurgery that electrocoagulation is the method par excellence for postoperative tonsillar remains, hypertrophies or regenerated tonsillar tissue. As previously

⁶⁶Arch. Phys. Ther., X Ray, Rad., Apr., '31.

⁶⁷Arch. Phys. Ther., X Ray, Rad., Jan., '31.

stated, it is reported that about three-fourths of all surgical tonsillectomies are incompletely performed. This percentage as given is too high for efficient operators. It will only be necessary, however, to witness some tonsil operations to be convinced that the number stated above is not exaggerated.

- "2. Lingual hypertrophy and varix;
- "3. Various fungus affections;
- "4. Blood dyscrasias such as hemophilia and anemia;
- "5. Various general conditions accompanied by serious involvement of the heart, lung and kidneys, and certain diseases such as syphilis, arthritis and sclerotic changes;
- "6. The aged and infirm;
- "7. The vast number of people who emphatically refuse surgical removal.

"An enormous amount of material is therefore readily available. Many of these patients would be deprived of the benefits attendant with the removal of the tonsils were it not for electro-surgery."

Dillinger Technic

The following technic which has been employed upon more than 3,000 cases by Gregg A. Dillinger, M.D., of Pittsburgh, Pennsylvania, will be found very satisfactory in electrocoagulation of tonsils.

Adjustment of the Machine

Close the spark interrupter points. Set the rheostat or the main control to about three-fourths of the full power of the machine, and make a dead short between the medium voltage and the indifferent outlets with one of your cords. Turn on the current and open the spark gaps until your milliamperemeter reads 2800. Now open the switch and connect one of the diathermy cords to a piece of heavy block tin 6"x10", which is to be placed on the patient's back. The second cord, connected to the needle, is attached to the other diathermy outlet.

Time of Contact

The consideration of importance is the time of contact with the tonsil and the active electrode or needle. (Nothing but a needle should ever be used, and see that the rubber sleeve covering it is pulled up over the end of the handle,* so as not to spark the tongue.) The time is not defined by seconds, but rather by the reaction of the tissues to the active electrode or needle; when

*Fischer's Catalog No. 244 carries the same needles as used by Dr. Dillinger, which are equipped with a bakelite sleeve that can be adjusted to or from the point of the needle as desired.

the point of coagulation is reached, a white ring appears around the needle. This requires anywhere from one to three seconds—never longer.

Anesthesia

For a local anesthetic Dillinger uses a 5 per cent solution of cocaine, wetting the cotton on an applicator only once with the solution. This is quickly applied to the soft palate, around the tonsil, inside the cheek and the base of the tongue, repeating this procedure five or six times with the same pledget of cotton, but no additional cocaine. Use no more than 4 or 5 drops for the whole procedure.

Dillinger never injects novocaine, because of the slight danger from the anesthetic; because more fluid is added to the field to dehydrate; and because there is about as much reaction from the fluid injected as from the diathermy.

Details of Application

The patient is seated in any kind of office chair. The large block tin electrode is applied to the bare skin of the patient's back, and connected by the insulated cord to the indifferent outlet on the machine.

Use a wooden or glass tongue depressor. Always have a nurse hold forward the anterior pillar with a glass or hard rubber pillar retractor. Never turn on the current unless you can absolutely see the exact location of the needle. It is imperative to know where the point of the needle is, and it must always be turned more or less toward the center of the tonsil.



Tongue Depressor

Now take the needle, the end slightly curved, put it from $\frac{1}{8}$ to $\frac{1}{4}$ in. into the tonsil, step on the foot switch. In from one to three seconds, when the white ring appears around the needle, release the current and take out the needle. This procedure is repeated until the tonsil has been covered with punctures about $\frac{1}{4}$ in. apart. The number of punctures varies according to the size of the tonsil. On large tonsils as many as twelve to fifteen may be required.

Now paint the tonsil with acriviolet, and the patient can go right on with his usual routine of the day.

TONSIL TREATMENT —Continued



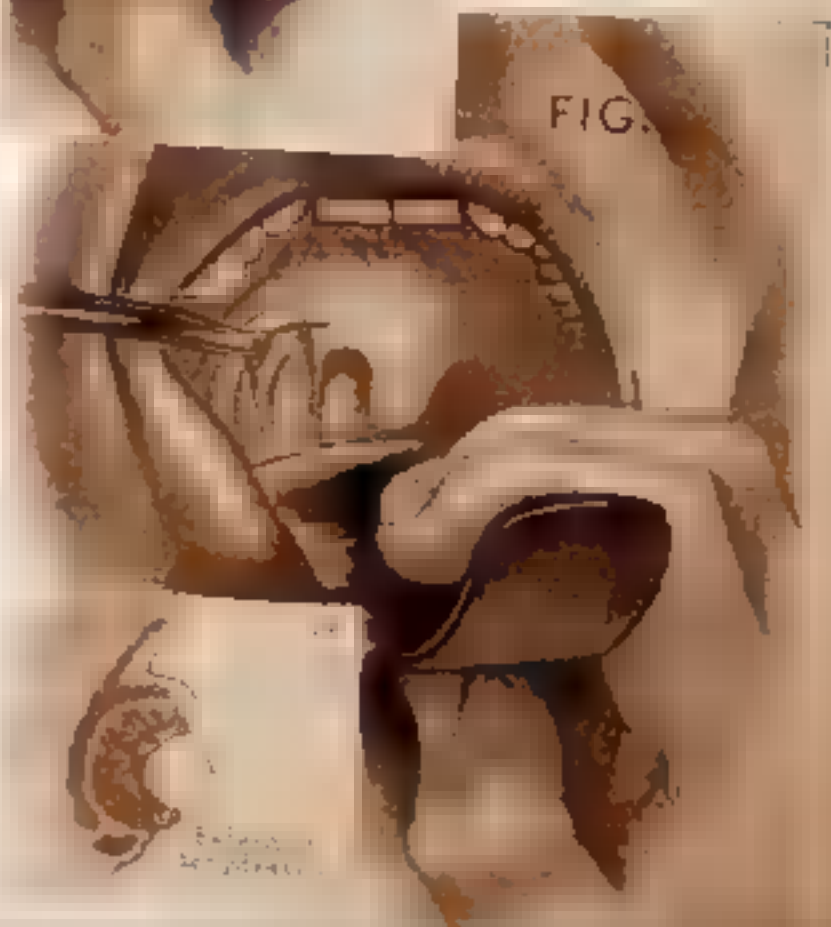
Fig. 1—First treatment. The diathermy coagulating needle is hooked into the tonsil midway between the pillars and near base of gland, pulling the tonsil slightly up out of its bed.

Fig. 2—Inspection after first diathermy treatment. Five or six areas of coagulation are seen on the face of the tonsil. These areas merge



into one about 24 hours later. Insert illustrates longitudinal section showing relation of coagulated area to needle point from a single puncture.

Fig. 3—Appearance of throat six or seven days after first treatment. Dehydration of the coagulated area is more complete, and the mass of tissue is reduced by about one-third.



TONSIL TREATMENT --Continued

Fig. 4—Appearance during second treatment. Hooking away of the tonsil tissue is to be stressed. When treating a thin layer of tonsil tissue very careful judgment must be used as to depth of penetration of needle and duration of contact.



Fig. 5—After third or fourth treatment. The fossa has been cleared except for a small tab or two. To treat these no attempt is made to hook or puncture. Rest the needle on the remaining tonsil tissue and very short electrical contact.

Fig. 6—Final inspection. Fossa perfectly clean, with the posterior pillar, anterior pillar and the plicatriangularis intact.

Multiple Tonsil Treatment Method Recommended

Dillinger's usual practice is to treat only one tonsil at a sitting. In seven or eight days the patient comes back; the tonsil operated upon has 50 to 75 per cent disappeared, and the other tonsil is treated. Both tonsils can be treated at one sitting and can be entirely removed with one treatment, but he strongly advises against this, as there will be greater reaction, and the patient is more uncomfortable than when only one tonsil is treated at a time. He prefers giving four to six treatments to each tonsil, and they are thus removed with no great inconvenience.

The third, fourth, fifth and, if necessary, the sixth treatment, are each distinctly different. You are working in less tissue, necessarily nearer the other throat structures; hence the need for greater care as to depth of penetration of needle. The last treatments often consist of only two or three punctures, and the last tissue that may be adherent to the posterior pillar can often be best removed by simply laying the belly of the needle against it and slightly coagulating it.

Caution

In every treatment be sure to have an assistant retract the anterior pillar, as the slightest coagulation of either pillar causes edema and pain. Do not touch the anterior or posterior muscles, and never remove the plica-triangularis. Thus there will be no scar tissue. Tissue that is adherent to these structures is easily removed with a little patience. A proper technic skillfully executed ensures success and a very grateful patient.



Pillar Retractor

Samuel R. Skillern, Jr., M.D., says,⁶⁵ "Over-coagulation or charring of tonsillar tissue favors early separation of the slough, if the coagulation has extended deep enough, and the walls of the vessels of the neck may be included in this slough, with dire results.

"Electro-coagulation is entirely a surgical procedure which can be employed for the successful removal of diseased tonsils in adult cases. With the proper technique this destructive agent is under definite control at all times, making this type of tonsillectomy a bloodless procedure, with no serious reaction, no shock, and eliminating toxemias."

⁶⁵ Va. Med. Mo.

New Bipolar Tonsil Treatment

J. A. Haiman, M.D., New York City, employs a method, which is based on the use of a new and improved Bipolar Tonsil Electrode which is self-contained; being constructed with two active curved needle electrodes which project one-quarter inch from its insulated handle, and are two millimeters apart. Such construction renders both needles active, which permits of coagulation in the space between the two needles only. This method eliminates the necessity of the large block-tin indifferent plate electrode as employed in other methods, and assures the precision of control that is requisite to good surgery.

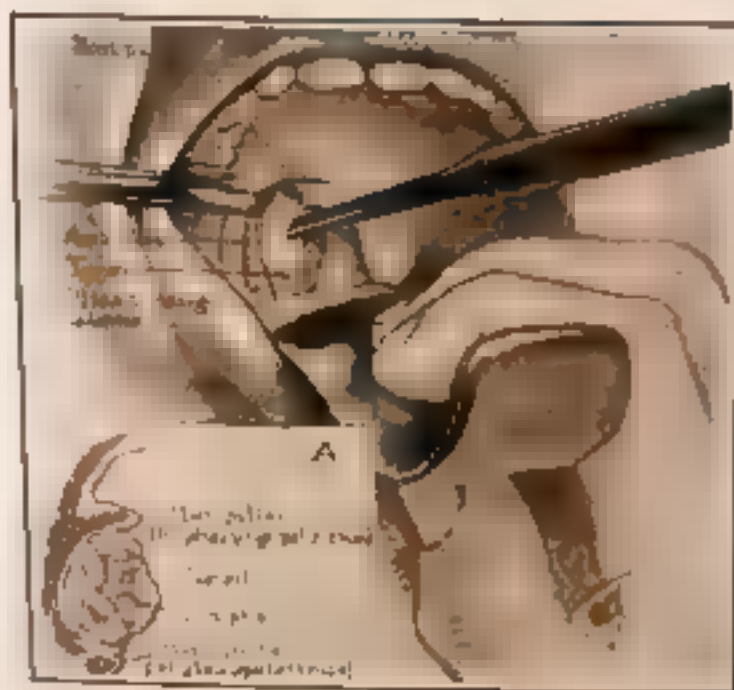
Bipolar tonsil coagulation, while being equally efficacious for the removal of small compact fibrous tonsils or large spongy hypertrophied lymphoid masses, also offers end-results comparable to a skilful surgical tonsillectomy; affords a clean, smooth, pliable fossa with preservation of normal contours of muscles of throat and without thickening these or adjacent structures.

Dr. Haiman's Technic

Under Dr. Haiman's Bipolar method the preparation of the patient is essentially the same as in the older technic, except that the Indifferent Plate Electrode is not used.

A 10 per cent cocaine solution is sparingly swabbed over the tonsil and adjacent structures.

The self-contained Bipolar Tonsil Electrode requires approxi-



Haiman Tonsil Treatment

mately two-thirds less current than the older technic, because the tissue resistance to be overcome between the two Bipolar needles is only two millimeters, as against the five or six inches of tissue resistance when the indifferent plate electrode is employed.

To establish the amount of current to be utilized, the two needle points of the Bipolar Tonsil Electrode are immersed in a small glass containing nor-

mal saline solution and the machine is adjusted to a reading of 350 milliamperes. This system permits of accurate duplication of current and affords the current reading which the machine is giving when the patient is actually in circuit thereafter.

The Bipolar Tonsil Electrode can be used to pick up the tonsillar tissue to be coagulated, and with the advantage that the double needles make this procedure considerably less difficult. It has been Dr. Haiman's practice to completely encircle the tonsil with successive insertions of the needles at intervals of about one-half centimeter, always inserting the needles from the lateral aspect of the tonsil and keeping the points toward its center, with slight but sufficient traction to relieve the tonsillar area to be coagulated, from its surrounding structure.

The Bipolar Tonsil Electrode needles having been engaged in the tonsil, coagulation is brought about by the manipulation of the foot-switch control and is carried just to the point of change of color of the tissue between the two needles,—*in never less than one second, and never more than two.* As with all coagulation technic, it is imperative that the electrode be engaged in the tonsillar tissue before compressing the foot-switch, and disengaged only after releasing the foot-switch.

Caution. Too much care cannot be exercised against overcoagulation. The objective is to coagulate just to a sufficient degree so as to divorce nutrition from that part of the tonsil which is to be destroyed, with the result that there is little or no pain or edema, and to have a perfectly clean, smooth fossa without thickening or scar tissue, when enucleation is completed.

The Bipolar Tonsil Electrode by reason of the accuracy of control lends itself readily to cleaning up remaining lymphoid tissue of the tonsillar fossae. In which case, small tabs are simply permitted to be squeezed up between the flat surface of the two active needle electrodes, without the necessity of actually inserting the needle points into the tissue.

In order that the patient may be perfectly comfortable at all times, it is advisable to treat but one tonsil at a time, allowing intervals of one week between the treatment of each tonsil. Occasionally, where desirable, both tonsils are treated at one time, following with the second treatment one week later. Usually patients do not complain of any more serious symptoms than a mild congestion of the throat, following treatment.

Several treatments may be required to remove the soft, friable type of tonsil and it is not uncommon to give five or six treatments to the very large fibrous tonsil.

Advantages of Diathermy in Tonsil Treatment

Dillinger says, "With the thin curved needle you can take away every particle of tonsil tissue and leave the pillars and soft palate in perfect, normal condition.

"Moreover, where you use the series method, with eight days intervening between treatments, you have an unobstructed view of your field each time, and every surgeon who knows the difference between muscle and soft tonsil tissue can tell when the tonsil is all out.

"Diathermy is suitable for the removal of all kinds of tonsils and in all cases, regardless of the diseases from which the patients may be suffering. There is no serious condition that I know of which contra-indicates the use of diathermy in the removal of the tonsil, except quinsy.

"This method should be brought to the attention of every general practitioner so that he may know that there is a method applicable to those cases where surgical tonsillectomy is contra-indicated, such as in the aged and infirm, in heart complications, tuberculosis, kidney disease, hemophilia, acute syphilis, and so on. Further, if this method is found suitable in the cases cited above, obviously it is desirable in all adult cases."

Dr. Balmer draws the following conclusions:

Electrosurgery is a valuable contribution to the practice of surgery, and a new adjuvant in the removal of tonsils.

The status of the orthodox surgical tonsillectomy is more secure since the advent of this method and its proper application.

A thorough knowledge of anatomy and surgical principles are prerequisite to the correct use of electrosurgical technic.

Since no procedure is ideal the surgeon should be trained to use the one most appropriate for the individual case.

Electrosurgery does not replace surgery in the removal of tonsils, but it is better suited in certain selected cases.

Electrocoagulation is the method, *par excellence*, for removal of postoperative tonsillar tissue and adhesions, lingual hypertrophy and varix, and for the extirpation of the faucial tonsil in the presence of certain diseases.

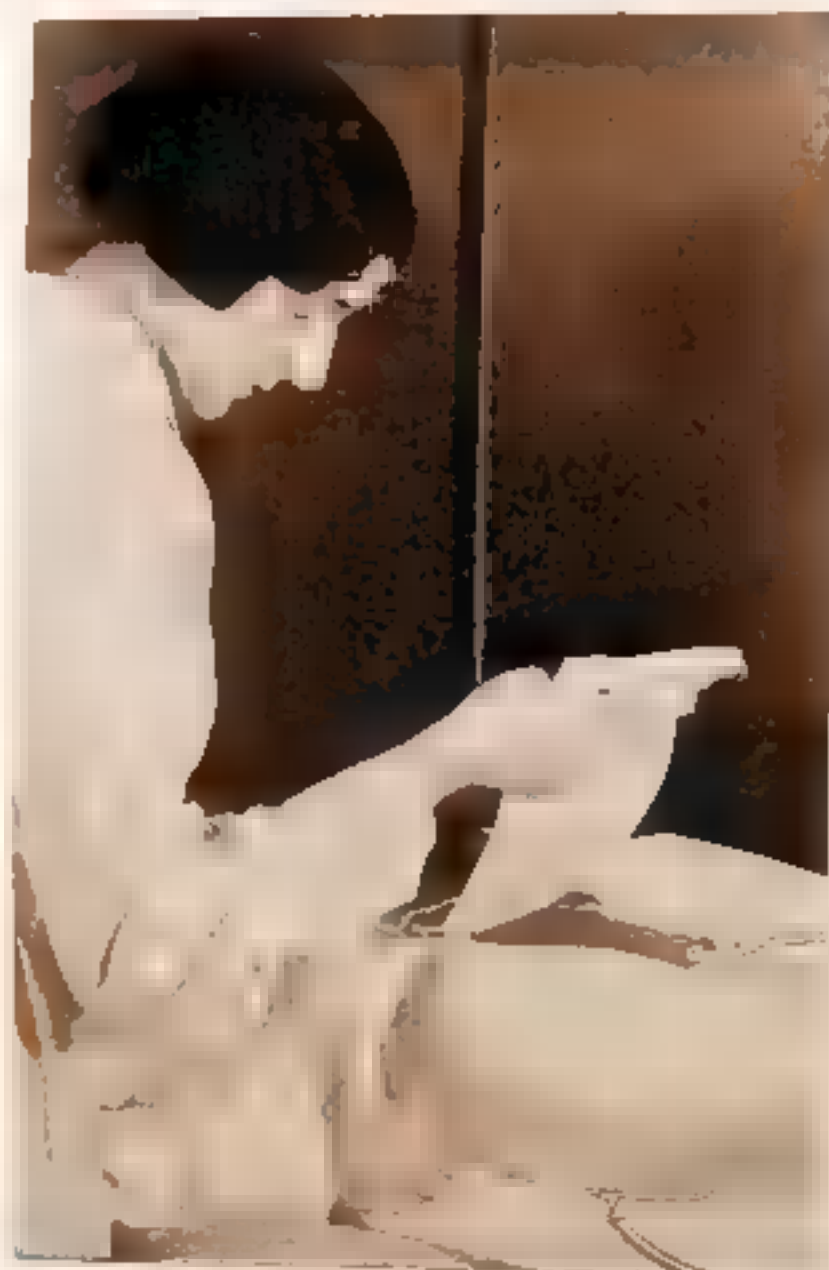
Electrocoagulation is not applicable in children, extremely nervous or refractory patients, and in patients in whom local operations are contraindicated.

TORTICOLLIS, ACUTE

Diathermy is very useful. Alternate deep diathermic applications with surface massage using the vacuum electrode.

TUBERCULOSIS OF THE HIP

Hip joint disease may nearly always be taken as an indication that tuberculous foci of infection exist elsewhere in the system. Some physicians hold that tuberculosis never is present anywhere in the body without a concurrent—or previous—infection of the lungs. Naturally, before an improvement of the hip lesion can be effected, these other focal sources of infection must be located and eliminated.



Block tin electrode, 4x7 in., is applied posteriorly as shown. Anteriorly, use block tin (shaped to body surface), held in place by sandbag.

Diet, fresh air and sunlight—all the usual physiotherapeutic measures—must be combined with local treatment. If there is pus present, as is quite likely to be the case, drainage may or may not be instituted. Patience is required in the treatment of this condition, on the part of both physician and patient.

Along with diathermy treatment, quartz lamp radiation of the entire body, the artificial sunlight treatment, is of benefit in this disease, as in all tuberculous affections.

These diathermic treatments help the tuberculous lesion by direct action. Attenuation of the bacilli is produced by the excessive temperature, furthermore, the heat automatically pro-

duces a vasodilation of the arterioles and venules with a great influx of freshly oxygenated blood to the part, as well as a concentration of the bactericidal enzymes of the blood, with a raising of the opsonic index. The vascular disturbance attracts leucocytes; phagocytic activity is increased and the infection stamped out. The heat and the healthy hyperemia favor repair. Fibroblasts are stimulated, disintegration products are absorbed, the calcium content of the tissues is raised and healing proceeds.

TUBERCULOSIS, PULMONARY

Physical therapy treatment in early pulmonary tuberculosis is of decided benefit if used with judgment in conjunction with the classic therapy of this disease. In no sense should diathermy be used alone, supplanting the excellent results obtained by the combination of rest, proper food, fresh air and sunlight, but rather supplementing these measures. Contributory causes—as infected tonsils—must of necessity receive attention. Indiscriminate use of diathermy must be avoided unless the operator has a clear mental picture of the diseased area. Confined pus is an absolute contraindication and while the danger of hemorrhage has been over-emphasized it is well to proceed with extreme caution in those cases with symptoms of hemorrhage.

The object sought in the use of this current is an acceleration of the natural action of the bodily forces fighting the disease rather than any destructive effect on the tubercle bacilli themselves. However, by relieving the area of venous stasis about the tubercle and replacing it with a fresh oxygenated blood supply which, as well as blood chemistry changes themselves, tend to inhibit the growth of the tubercle bacillus and render an otherwise favorable cultural location untenable. Locally all of nature's forces of repair are stimulated, the tubercle more firmly walled off, liberated toxins eliminated or broken up.

For a few days following treatment the symptoms increase, followed by a decrease of expectoration, cough, increase of appetite, improvement of color, lower temperature, gain in weight and a feeling of well-being very encouraging to the patient.

Treat the patient as an individual. Tuberculosis is seldom an uncomplicated disease. Technic must be adapted to fit the case. As a rule use block tin electrodes so placed that the area to be treated lies between. With patient in prone position, the upper electrode had best be weighted down by a small sand bag to maintain contact. Maintain what to the patient is a good comfortable heat for a period of 20 minutes at first, up to seances of 45 minutes to one hour. Treat daily—and over a long period of time—persistence will be rewarded.

In the far-advanced cases, while little can be done to influence the final result, diathermy will make the patients much more comfortable both to themselves and families through the amelioration of symptoms.

Results are more striking if the diathermy treatments are followed by properly controlled applications of ultra-violet light.

Curran Pope, M.D., says: "Hydrology, diathermy and light are the best physical measures. Their combination is much better than their use alone. In acute cases the cold chest pack and actinic light. In chronic cases the dripping sheet, showers, sprays and douches, gradually reduced until the patient can take very cold temperatures for short periods.

"*Diathermy* must be very cautiously employed at first. A hemorrhage may occur but the chances are small. Commence with small doses, 200 to 300 milliamperes for five minutes and gradually increase to 750 to 1,000 milliamperes for 10 to 15 minutes. It may be given at first three times weekly, later six times weekly. The danger of hemorrhage may be lessened and the patient helped by fractional doses of X-Ray."

Harry Eaton Stewart, M.D., says, "Diathermy has been used in pulmonary tuberculosis in a few scattered cases. The reports given out regarding the result of this treatment are exceedingly optimistic. Before any such reports can be accepted at their face value very complete data are necessary in a large series of cases. In order to be free from danger even experimental work in this line must be done with these points in mind:

"1. Where there is the slightest tendency to pulmonary hemorrhage, diathermy would be absolutely contraindicated.

"2. It should never be used in the place of, but only in addition to, every other accepted means of aiding in this disease.

"3. Its association with ultraviolet irradiation in those who respond to this, is especially indicated.

"4. It would seem that the only stages of this disease logically amenable to treatment by diathermy are those of incipency and fairly well-advanced encapsulation."



Pulmonary Tuberculosis — Illustration shows application of chest electrode for lesion in apex of left lung

Burton Baker Grover, M.D., says, "While diathermy of a tuberculous lung hastens the elimination of toxins, it does not directly 'kill off' the bacillus. Through dilatation of the pulmonary blood vessels the lung is flooded with freshly oxygenated blood and a consequent increase of phagocytes assist in the clearing up of infiltrated areas. Diathermy is of considerable importance in the treatment of pulmonary tuberculosis, but we should treat the subject conservently." In his Sixth Edition of "High Frequency Practice," he adds: "Theoretically there is a possibility of hemoptysis following diathermy. However, the author has never seen nor heard of diathermy being followed by more than blood-stained sputum. In previous editions of this work the author has stated that diathermy should not be employed in cases of tuberculosis with a temperature over 100 degrees F. Further experience in treating this disease teaches that diathermy is often followed by reduction of temperature. I have seen cases where a temperature of 103° F. was reduced to 100° F. by one treatment of diathermy. Walled-in pus still remains as a positive contraindication to its use."

TUBERCULOUS OSTEOMYELITIS

This malady, formerly considered as a case for surgical intervention, plaster casts and weights, has yielded to physiotherapeutic treatment to a gratifying extent. Naturally, after diagnosis has been confirmed, the usual steps are taken to regulate diet, elimination and contributory causes such as tuberculous infections elsewhere in the body. The diathermy treatment is perhaps best illustrated by quoting a typical case:

Patient aged 12 years. Left knee swollen and painful since two years of age. At times quiescent, but never reduced in size to normal, and on the least exposure to cold, or if over-exercised, the knee would swell, become red and extremely painful and child would be confined to bed for weeks. A diagnosis of tuberculosis of the bone was made by X-ray, and diathermy treatment prescribed. Plate electrodes cut from block tin and shaped to the contour of the leg were applied on each side of the swollen portion of the leg and held in place by an elastic bandage. 1500 milliamperes of current was passed through the leg for thirty minutes each day for six treatments. A red spot appeared after the third diathermy treatment which became necrotic in the center. This was lanced, a quantity of pus evacuated and sterile dressings applied until the sinus healed.

TUBERCULOUS GLANDS

Tubercular adenitis, if seen before suppuration has taken place, and the gland and adjacent tissues have broken down, can frequently be aborted by the combined use of X-rays locally, and the ultra violet ray given as general body radiations. If suppuration occurs or has occurred, the abscess should be aspirated, passing the needle through healthy tissue into the pus pocket, to avoid producing an open wound and mixed infection.

Ultra violet ray is invaluable in these cases. Diathermy is of value after drainage, either spontaneous or induced, has occurred.

TURBINATES, HYPERTROPHIED

Anesthetize the mucous membrane and, using a pointed electrode, reduce the turbinate by electro-surgical coagulation. For technic, see surgical diathermy.

Butyn 2% or cocaine 1% with adrenalin is applied locally on cotton as a tampon for 5 minutes. A diathermy plate, 3x6 inches, is now applied to the back of the neck and attached to the indifferent terminal by an insulated cord. A second cord is attached to the medium voltage pole and the other end in the holder of the Applicator. The current is now tested out by shorting the Applicator upon the indifferent pole. The rheostat set on 1, and the fine adjustment on the condenser should be set with a fine spark so that the milliamperemeter will read 400. Now advance the rheostat to the 2nd and 3rd button so the milliamperemeter registers about 1200 or 1500. This will give you a high milliamperage with a low voltage.

Separate the nasal alae with a nasal speculum and apply the Applicator to the affected turbinate, flatwise with gentle but firm pressure, keeping away from the septum.

With foot switch, test the patient out with one or two short flashes. If tolerated without pain hold the current on for about five seconds. One application to an area is sufficient. Then move above or below or posteriorly as the size of the turbinate may require and repeat the application.

Upon the second day the mucous membrane becomes swollen and congested but from the third day on for two weeks the membrane gradually shrinks until a free air passage is obtained. The after treatment consist of a douche or wash with normal salt

solution and every other day swab out the nasal passage with 10% argyrol solution; and thus observing the patient, you will note a gradual atrophy of the thickened membrane taking place and your patient will tell you he breathes better and has more air space.

In Drs. Beck and Guttman's turbinate reduction by coagulation with surgical diathermy currents, a long fine surgical needle insulated to within one-eighth of an inch of the point, is mounted upon a suitable base for use in the Dillinger Coagulation Handle. This needle is introduced at the anterior base of the turbinate to the length of the turbinate, and then the currents are turned on and coagulation takes place as the needle is withdrawn thus creating a ridge of coagulation within the turbinate next to the bone, which results in the creation of fibrous tissue and the natural reduction of the turbinate with no damage to the mucous membrane except at the point where the needle has entered. If care is taken during withdrawal to prevent coagulation at that point, you will have no loss of mucous membrane.

ULCER, DUODENAL

See Duodenal Ulcer, page 59.

UTERINE CERVICAL LESIONS

See Cervicitis, pages 51 to 55.

Frank M. Mikels, M.D., Los Angeles, says,⁶⁹ "That electro-surgery is the most conservative method for the treatment of uterine cervical lesions. Electrosurgery is more efficacious in treating erosions and chronic infections of the cervix than any other method. Electrosurgery destroys infection and produces an end-result which does not impair the function of the musculature of the cervix. Electrosurgical methods of treating the chronic Neisserian infection has proved reliable. The final results of extensive coagulation of cervical erosions complicated with lacerations do not interfere in any way with successful plastic operations for repair but leave a clearer and cleaner field for this procedure.

The medical profession as a whole and obstetricians or gynecologists in particular should give electrosurgery as a therapeutic agent careful consideration and respectful recognition in so far as it is valuable as a method of conserving the function of the regenerative organs and preventing the incidence of cancer of the cervix.

⁶⁹ *Am. Jour. Surg.*, Dec., '29.

URETHRITIS

For female, see section on Diathermy in Gynecology, pp. 70 to 74. In treating the male, see section on Gonorrhea, pp. 67 to 69.

VAGINISMUS

See Diathermy in Gynecology, pp. 70 to 74.

VAGINITIS

See Diathermy in Gynecology, pp. 70 to 74.

VARICOSE ULCERS

Diathermy may be employed for relief of the pain, and to increase local nutrition and metabolism but compression and drainage of the engorged veins is essential.

L. J. Belknap, M.D., says, "I have treated many cases of varicose ulcers of the leg with prompt results with diathermy, using 500 M.A. from 20 minutes to 40 minutes, followed by ultra-violet local and body. The diathermy seems to powerfully stimulate nutrition and increase the circulation in the leg."

VARICOSE VEINS

See Varicose Ulcers, above.

VESICULITIS, SEMINAL

Apply mesh covered sponge electrode to anus or special prostatic electrode in the rectum inserted so as to come in contact with the vesicles of the two sides successively. Large block tin or mesh electrode over abdomen. The perineum should be shaved and soap lather applied to prevent sparking. Treat with bladder distended. After treatment, have the patient evacuate the bladder. This washes out all waste products and cellular debris. Elevate the amperage to the skin tolerance and treat twenty to thirty minutes. It is also possible to treat this condition with the special prostatic electrode, but the above procedure is more comfortable to the patient.

WARTS

See Benign Skin Blemishes, pp. 106 to 108.



WRIST AND FINGER, DIATHERMY TO

At Left—Electrode on wrist, other in basin of water in which finger is immersed. 200 milliamperes for twenty minutes. Patient must be cautioned against lowering other fingers or hand into water or touching pan as a spark will be produced that is unpleasant, and always startles an inexperienced patient. The older patients learn to avoid this. (Chapman Clinic)

WRIST AND FINGERS, DIATHERMY TO

At Right—Cuff electrode around wrist, hand resting on sponge in basin of water in which other electrode is immersed. Fingers are inserted in water to desired depth, to bring heat to affected joints. 500 milliamperes for 20 minutes.



WRIST, DIATHERMY TO

At Right — Cuff electrode to wrist, hand immersed in basin of water containing other electrode. Heat is thus concentrated at wrist joint. 500 to 700 milliamperes for 20 minutes.



WRIST, DIATHERMY TO

At Left — Showing application of two electrodes one on either side of wrist, held in place by elastic bandage. 600 milliamperes for 20 minutes.

DIATHERMY

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DIATHERMY

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Diathermy, or internal baking, has masqueraded under a number of synonyms such as diathermia, thermo-penetration, thermofaradic (as its name indicates, a poor diathermy), endothermy, etc.

While it is a high frequency current, ordinarily of the D'Arsonval type with a fairly high voltage and milliamperage, yet in practice it varies widely, dependent upon the construction of the high frequency apparatus employed. It is evident that a machine wound to give a high milliamperage and a relative low voltage will have less ability to overcome resistance and consequently less power of deep tissue penetration than one constructed to deliver a much higher voltage with a somewhat less milliamperage. It should have voltage enough, however, to insure its passage in parallel lines from one electrode to the other. In all other electrical currents, except perhaps the static, the electrical lines of force do not go in straight lines through the tissue from electrode to electrode, but are diffused in widely divergent ones, and are only concentrated at the points of contact of the electrodes. Hence it necessarily follows that the deeper structures are much less under the influence of the electrical current. Diathermy, on the contrary, provided as stated above the voltage is sufficient, flows in a straight line from electrode to electrode and the intervening tissues are generally well heated with of course a greater intensity of heat nearer the smaller electrode. It is this process of generating heat *within* the tissues that makes diathermy so valuable. All other forms of heat are to a great degree blocked in their penetration by the skin, whether they are conductive heat such as the hot water bottle or electric heating pad, or convective heat such as incandescent light applicators or the arc light. Diathermy, however, is true conversive heat, that is, heat generated in the tissues, hence it penetrates deeply and to a great degree uniformly.

The penetration and clinical results of the infra red rays, despite generous advertising is still a mooted question.

Diathermy then is a high frequency current ordinarily of the D'Arsonval type with sufficient voltage to overcome tissue resistance, and with sufficient ampereage or quantity to heat, because of internal tissue resistance, the structures through which it passes, as it flows in straight lines from one electrode to the other.

Diathermy may be divided into medical and surgical diathermy. Surgical diathermy which includes electro-coagulation and dessication will not be considered in this paper.

Medical diathermy may be divided into direct and indirect diathermy. The indirect type will also be omitted in this paper, auto-condensation being the most important example.

METHODS OF APPLICATION OF DIRECT DIATHERMY

1. Lateral method
2. Double cuff method
3. Cuff and water method

Of these the first, the lateral method insures the greatest concentration of heat to a given local area in the shortest time. The cuff method is also efficient but requires a much longer time of application. The cuff and water method is the least efficient. It is ordinarily used where the toes or fingers are to be diathermatized.

MATERIALS

Only ■ metal contact should be employed such as block tin, preferably 22 gauge, Crooke's metal, organ pipe metal, limpit metal, or metal mesh. The interposition of moist cotton, felt, or asbestos increases greatly the chances of a burn. Either one or two things may happen. The pads may become dry, more resistance ensues, carbonization takes place, and the tissue is showered with fulgeration sparks; or as has happened with the asbestos type, the metal back may become disintegrated and the area of contact be thus greatly reduced in size with consequent concentration of current strength, and an electrocoagulation of the part under treatment. Great care should be taken in preparing metal electrodes. They should not have any sharp edges. They should be perfectly smooth so that no undue pressure might be exerted. If they have been used before, good contacts should be ensured by smoothing them with a squeegee, or even ■ large static spark ball. In hospital practice the skin is well lathered before the electrodes are applied. In the office, where there is presumably less rush and Aides with wider experience, the electrodes are dropped into basins of hot water in order that the metal may feel warm, and are placed in position with only the small amount of moisture present which may cling to them. If the current is gradually turned on, the resistance of the skin should be overcome without any discomfort to the patient. If the part is hairy it should be well lathered or shaved. The electrodes should then be bound on with an elastic bandage such as the Ace. A paper or cotton bandage may also be employed. I ordinarily use a cotton bandage or a rubber strap (old inner tubes are handy for that purpose). The contacts should be exact, and if the patient complains of burning or prickling the metal should be firmly pressed against the skin over the area in question. If this does not give relief, the metal should be reapplied. This is important, for if the metal is not in close contact with the skin, the passage of minute sparks will in time either fulgerate or coagulate, and a high frequency burn will ensue. These burns are not ordinarily harmful, unless they are deep enough to cause ■ scar, but they are bad technic. If by any chance the skin is anesthetic, the greatest care should be employed. Much has been written concerning the swelling of the tissues under the diathermic electrodes. I think that this has been overstated, and it is much better to bind on snugly enough to secure good contact, thus avoiding a burn. As stated above it is better to use a bandage which is somewhat elastic. A gauze bandage may exert undue pressure on some part, and from this excessive pressure and the resultant ischemia, a burn may result. For this reason also it is well to avoid bony prominences.

DOSAGE

From 50 to 100 milliamperes per square inch of contact is ordinarily sufficient. If the arteries are sclerotic, 50 milliamperes is better than 100.

SPARK GAP

The spark gap should be in good working order, special attention being paid to its cleanliness. It is better to have the spark gaps fairly close and to increase the amount of current by allowing more to come in from the alternating current mains rather than to use a wide open, spluttering spark gap as thereby a faradic character may be imparted to the diathermy which would not only be more disagreeable to the patient, and less current could be used, but it would also act as a stimulating diathermy rather than as a sedative one.

TIME OF TREATMENT

This cannot be exactly interpreted in minutes as the result and the reaction are the main factors. In general it takes at least 20 minutes to heat thoroughly a part. With the double cuff method the treatment should be continued until the skin between the inner edges of the electrodes becomes hot. This may take from 20 to 60 minutes.

FREQUENCY OF TREATMENT

This depends on the underlying pathology. For the relief of pain, or in a pneumonia, one or two treatments a day may be necessary. In non-union or delayed union of bone, two or three times a week will suffice.

SPECIAL TECHNIC FOR JOINTS

1. Toes and fingers. Here a combined cuff and water bath is best. For the toes the foot is plunged in a basin with just enough water to cover half the depth of the foot, and a metal cuff is affixed two inches above the ankle; or if allowing the leg to hang down causes pain or throbbing, the patient may lie on a table with his feet hanging over the edge with the tips of his toes inserted in the water. Of course, one cord from the high frequency machine is inserted in the water, care being taken not to allow it to come in contact with the skin. In a similar way the finger or fingers are inserted into the water bath (a glass candy jar makes a convenient receptacle) and a metal cuff applied approximately two inches above the wrist—400 to 600 milliamperes.—

2. Ankle and wrist. Double cuff is the best. One cuff should be firmly bound around the toes or fingers, and if the parts are well lathered, there should be no prickling. The other cuff should be placed two to four inches above the joints,—400 to 800 milliamperes.

3. Knee. As a rule the lateral method is more efficacious. Care should be taken to so center the electrodes that "skin effects" may be avoided. The electrodes should be of oval shape and dependent on the size of the knees, should have an area of from 8 to 12 square inches each.—600 to 900 milliamperes.

4. Hip. The antero-posterior method is the best. An oval electrode, four by six inches (24 square inches) is placed anteriorly over the groin with its center over Poupert's ligament, while posteriorly and diametrically opposite an oval electrode 5 by 7 inches is inserted under the patient. A sandbag will hold the anterior electrode securely—800 to 1,000 milliamperes.

5. Spine. Two methods are available, the antero-posterior and the longitudinal. The latter has greater skin effects and really heats the spine by conduction. For this method, two metal electrodes are placed, one 4 by 3 inches over the cervical region, the other 5 by 7 inches over the sacrum. If the patient rests upon pillows, good contact is assured, though if it is desired the electrodes may be affixed with adhesive plaster—800 to 1,000 milliamperes.

ANTERO-POSTERIOR METHOD

a. Cervical region. Place a 2 by 6 electrode over the cervical spine, the patient preferably lying on his back; hold by means of a sand bag a 5 by 7 electrode over the chest—700 to 900 milliamperes.

b. Thoracic and lumbar region. Use a 2 by 10 inch electrode posteriorly and a 10 by 12 anteriorly. This can be readily held on the abdomen by a sandbag, the patient of course being recumbent,—800 to 1,200 milliamperes.

6. Shoulder. The shoulder joint is notoriously hard from a diathermic standpoint. Many mechanical devices have been offered to hold the electrodes in position. With any rigid support, though, there is danger of undue pressure. It is hard to bind on small metal electrodes. So far the only solution I have found is by the use of metal mesh spread over a rubber sponge. This type of electrode can be readily bound over the joint, and the resiliency of the rubber will prevent undue pressure. The sponge should be moistened, otherwise, due to the heat there will be a burnt rubber smell—600 to 800 milliamperes.

7. Elbow. With the elbow the double cuff method is best. Two cuffs, one, two inches above, the other two inches below, the elbow will in a short time thoroughly heat the joint,—400 to 800 milliamperes.

It is useless to wrap chain mesh around the joint and expect any heating of the joint. That this is so, may readily be proved by taking a piece of meat, encircling each end with a cuff and turning on sufficient current to cook the meat. Under the cuff the meat will be found cold and uncooked, while between the inner edges of both cuffs the meat will be steaming hot and well cooked.

OTHER SPECIAL APPLICATIONS OF DIATHERMY

1. Sinuses.

a. Frontal. Bind on by an elastic bandage or rubber band, over the region of the sinus, a 2 by 4 electrode, first lathering the skin. Similarly apply a 4 by 6 electrode to the cervical region. If possible have the patient recumbent, otherwise bind it securely by a bandage. The only difficulty of this is the choking sensation which may ensue.—300 to 500 milliamperes.

b. Antrum. Employ the lateral method by holding or binding a 4 by 5 electrode over the unaffected side of the face, and a circular two inch in diameter electrode in a wooden handle held firmly over the antrum,—200 to 400 milliamperes.

2. Brain. Treat as in frontal sinus. Recurrent bleeding as in certain types of hemiplegia is a contra indication,—300 to 500 milliamperes.

3. Eyes. Use a curved double eye non-vacuum electrode over the eyes with a 4 by 6 electrode over the cervical region as in frontal sinus. With the curved type of non-vacuum electrode, the patient can readily lie down and hold the electrode with comfort.

4. Middle Ear. Bind a cuff on each wrist. Have the patient insert his little finger in the external auditory canal, giving as much current as the patient can stand without effort. If it is impossible to regulate the strength of the current finely enough, have the patient touch his face with one or more of the other fingers, thus using the fingers as a rheostat,—100 to 600 milliamperes.

5. Kidney. Use a 4 by 5 oval electrode posteriorly over the kidney, patient preferably recumbent, with a 8 by 10 electrode anteriorly, held by a sandbag or hot water bottle over the abdomen,—600 to 1,000 milliamperes.

6. Spastic Gut. Frequently in treating cases of constipation, one portion of the colon usually in the vicinity of the sigmoid will be found to be spastic. This can be relieved by diathermy. Technic. Cut an electrode large enough to cover the spastic area anteriorly, and place over the lumbar region an indifferent electrode approximately twice as large. Patient recumbent,—600 to 1,000 milliamperes.

7. Coccyx. In coccygodynia diathermy will often afford prompt and lasting relief. Cut out an electrode the size and shape of the coccyx with a flange projecting either to the right or left depending on the location of the referred pain. Have the patient lie on his belly, insert a curved insulated rectal electrode so turned that the metal end will come in contact with the coccyx internally, and mould over the coccyx externally the specially prepared electrode. Hold it in place by a sandbag,—300 to 800 milliamperes.

8. Chest. For pneumonia, bronchitis, asthma, and angina, diathermy may be of value. I have never found any bad effects on the heart with this procedure. 6 by 9 electrodes should be placed anteriorly and posteriorly, the posterior one more to the left, the anterior one more to the right. 1,000 to 1,800 milliamperes may be safely used. It is well to turn the current on gradually, taking 3 to 4 minutes before attaining the maximum strength. The anterior electrode may be held on by a sandbag, hot water bottle, the hand of the operator, or adhesive plaster. The duration of the treatment should be at least 30 minutes.

I have some hesitancy in mentioning milliamperage, for there are such things as high speed meters. I have tested meters which registered twice the amount that my other meters did under exactly the same conditions. Until we can secure standardization, it will be necessary for each physician to work out his own standard for his own particular machine or machines.

Not infrequently it is possible to treat two joints at once, such as both knees, shoulders, hips. For this purpose there is necessary visible to treat two dissimilar joints at the same time, such as knee and elbow, as the current strength will vary owing to differing degrees of resistance. It is also necessary to take care that the conducting cord (rheophore) or the metal parts of the connector be well insulated from the patient. Dry absorbent cotton or a towel will suffice.

There are many types of connectors. The two I use most are, first, the safety pin, and second the Morse Eureka clip. Some have complained that the latter, the clip, will release its hold when the weight of the patient's body is put upon it. I have not had this experience.

SPECIAL INDICATIONS FOR DIATHERMY

1. Non-union or delayed union of bone. Here diathermy, where a fair degree of fixation of bone can be secured, is of value. Whenever possible the lateral method is used. If apparatus can not be removed, the cuff method is best. Frequently if the part is encased in a plaster cast, windows can be cut in the cast anteriorly and posteriorly, one a little below and the other a little above the break. Through these windows can be inserted the metal electrodes and a fair lateral treatment can be given. I have never seen any harm result from the so-called swelling of the parts treated. 400 to 700 milliamperes every two or three days is usually often enough. In some cases, bone grafts first, and diathermy following seems to shorten disability.

2. Bursitis, especially subdeltoid with calcification. Whether calcified bursae disappear spontaneously, I know not, but at all events under diathermy and chlorine ionization through the shoulder followed by massage and gentle manipulation, they are doing it now.

3. Hyperthrophic arthritis. Here, provided overgrowth of bone is not a mechanical obstruction, and even though the X-Ray picture remains unchanged, prompt symptomatic relief is usually obtained by diathermy and ionization. Numerous cases physically incapacitated are returned to gainful occupations for periods of many months. A relapse occurring, relatively fewer treatments will send them on their way rejoicing, for the time symptomatically cured.

4. Pneumonia. An internal poultice such as is afforded by diathermy, the increased local temperature (nature's method), the increased hyperemia and drainage, and the augmented phagocytosis all seem to mark the use of diathermy as a rational procedure. Often the improvement in the pulse, disappearance of cyanosis, and the decrease of pain, is coincident with the treatment. The technic has been given above. Treatments may be given twice daily.

5. Bronchitis. Lately I have treated several cases of chronic bronchitis with cough, by means of diathermy and air-cooled ultra violet. So far the results have been very satisfactory, but many more cases must be thus treated before we have any right to make any claim for this procedure.

6. Asthma. So called essential asthma is in the same category as bronchitis, both as to technic of treatment and claims as to results: only it would seem rational to expect that the relaxing effects of diathermy ought to relieve the muscular spasm.

7. Neuritis. Frequently a very acute neuritis will be more quickly relieved as regards pain, by diathermy than by any other method. The double cuff technic is usually employed. In brachial neuritis, not infrequently the cervical and upper thoracic spine is affected, hence in such cases I employ the following technic: Suppose it is the right arm—place a semicircular strip of metal over the left side of the spine, and a cuff over the upper arm. Diathermatize until the shoulder is hot. 600 to 900 milliamperes. Remove the cuff from the upper arm and place it around the wrist continuing until the whole arm is hot. The first treatment will often cause increased pain, but this apparently is not a bad sign.

8. Spasticity. This is best treated by diathermatizing the appropriate centers in the spine, and then by the double cuff method, heating the spastic muscles.

9. Osteomyelitis, chronic. Here again, a combination of the double cuff method of diathermy and general and local air-cooled ultra violet is of value.

10. Pain. Local pain is frequently ameliorated by diathermy.

Contra-indications to diathermy. There are two such contra-indications.

1. Pus without drainage.

2. Lesions where there is likelihood of hemorrhage.

This latter includes pulmonary tuberculosis, ulcers of stomach and viscera, and recurrent hemorrhage in the brain.

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